GUESS PAPER & MODEL PAPER # 01
BASED ON CHAPTER # 9 (Reduced Syllabus)
CHEMICAL EQUILIBRIUM

CHAPTER 9 : CHEMICAL EQUILIBRIUM

Topics: Reversible reaction and dynamic equilibrium, Law of mass action and its derivation, equilibrium constant and its unit, importance of equilibrium constant.

Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

(i) Which is true about the equilibrium state?
A. The forward reaction stops. B. The reverse reaction stops.
C. Both forward and reverse reactions stop.
D. Both forward and reverse reactions continue at the same rate.

(ii) When a mixture of H_2 and I_2 is sealed in a flask and temperature is kept at 25 °C, following equilibrium is established. $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$
Which substance or substances will be present in the equilibrium mixture?
A. H_2 and I_2 B. HI only C. H_2 only D. H_2, I_2 and HI

(iii) What are the units for $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)}$
A. $mol.dm^{-3}$ B. $mol^2.dm^{-6}$ C. $dm^3.mol^{-1}$ D. No units

(iv) Which of the following reaction will not have any units for K_c?
A. $H_{2(g)} + CO_{2(g)} \rightleftharpoons H_2O_{(g)} + CO_{(g)}$
B. $N_{2(g)} + O_2 \rightleftharpoons 2NO_{(g)}$
C. $2A_{(g)} + B_{(g)} \rightleftharpoons 3AC_{(g)}$
D. All of these

(v) Concentration of reactants and products at equilibrium remains unchanged if
A. concentration of any reactant or product is not changed.
B. temperature of the reaction is not changed.
C. pressure or volume of the system is not changed.
D. all of the above are observed

(vi) Which of the following does not happen, when a system is at equilibrium state?
A. Forward and reverse reactions stop.
B. Forward and reverse rates become equal.
C. Concentration of reactants and products stop changing.
D. Reaction continues to occur in both the directions.

(vii) For which reaction, K_c has units of $mol.dm^{-3}$.
A. $2NO_{2(g)} \rightleftharpoons N_2O_{4(g)}$

(viii) In an irreversible reaction equilibrium is

A. established quickly B. established slowly
C. never established D. established when reaction stops.

(ix) Active mass means

A. total mass of reactants B. total mass of products
C. total mass of reactants and products
D. mass of substance in moles per dm^3 in a dilute solution

(x) For a reversible reaction $K_c = \frac{[C]^2}{[A][B]}$. Which substance is product of the reaction?

A. A B. B C. Both A and B D. C

(xi) Two chemists C.M Guldberg and P. Waage in ________ proposed the law of mass action to describe the equilibrium state.

A. 1864 B. 1865 C. 1867 D. 1869

(xii) $K_c = \frac{K_f}{K_r}$ is known as ____________.

A. ionization constant B. dissociation constant
C. rate constant D. equilibrium constant

CHEMISTRY SSC-II

Time allowed: 2:40 hours **Total Marks: 53**

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

i. **Differentiate between forward and reverse reactions.**

ii. **What is chemical equilibrium?**

iii. **Write the law of Mass Action.**

iv. **Write both forward and reverse reactions?**

a. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

b. $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

v. **What is the importance of equilibrium constant for a chemical reaction?**

vi. **Following reaction can occur during lightning storms** $3O_{2(g)} \rightleftharpoons 2O_{3(g)}$
For this reaction write

(a) **Equilibrium constant expression.**
(b) **Determine the units of equilibrium constant.**
(c) **Forward and reverse reactions.**

vii. **Coal reacts with hot steam to form CO and H_2. These substances react further in the presence of a catalyst to give methane and water vapour.**

$$CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$$

(a) **Write forward and reverse reactions for it.**
(b) **Derive K_c expression for the reaction.**
(c) **Determine units for K_c**

viii. **Determine the units of equilibrium constants for the following reactions.**

(a) $COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)}$ (b) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

(c) $2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)}$ (d) $N_{2(g)} + 2O_{2(g)} \rightleftharpoons 2NO_2$

SECTION – C (Marks 15)

ختم نبوت ﷺ زندہ باد | **عظمت صحابہ زندہ باد**

السلام علیکم ورحمۃ اللہ وبرکاتہ:

معزز ممبران: آپ کا وٹس ایپ گروپ ایڈمن "**اردو بکس**" آپ سے مخاطب ہے۔

آپ تمام ممبران سے گزارش ہے کہ:

- گروپ میں صرف PDF کتب پوسٹ کی جاتی ہیں لہذا کتب کے متعلق اپنے کمنٹس / ریویوز ضرور دیں۔ گروپ میں بغیر ایڈمن کی اجازت کے کسی بھی قسم کی (اسلامی وغیر اسلامی، اخلاقی، تحریری) پوسٹ کرنا سختی سے منع ہے۔
- گروپ میں معزز، پڑھے لکھے، سلجھے ہوئے ممبرز موجود ہیں اخلاقیات کی پابندی کریں اور گروپ رولز کو فالو کریں بصورت دیگر معزز ممبرز کی بہتری کی خاطر ریموو کر دیا جائے گا۔
- کوئی بھی ممبر کسی بھی ممبر کو انباکس میں میسج، مس کال، کال نہیں کرے گا۔ رپورٹ پر فوری ریموو کرکے کاروائی عمل میں لائے جائے گی۔
- ہمارے کسی بھی گروپ میں سیاسی و فرقہ واریت کی بحث کی قطعاً کوئی گنجائش نہیں ہے۔
- اگر کسی کو بھی گروپ کے متعلق کسی قسم کی شکایت یا تجویز کی صورت میں ایڈمن سے رابطہ کیجیے۔
- سب سے اہم بات:

گروپ میں کسی بھی قادیانی، مرزائی، احمدی، گستاخِ رسول، گستاخِ امہات المؤمنین، گستاخِ صحابہ و خلفائے راشدین حضرت ابو بکر صدیق، حضرت عمر فاروق، حضرت عثمان غنی، حضرت علی المرتضیٰ، حضرت حسنین کریمین رضوان اللہ تعالیٰ اجمعین، گستاخِ اہلبیت یا ایسے غیر مسلم جو اسلام اور پاکستان کے خلاف پراپیگنڈا میں مصروف ہیں یا ان کے روحانی وذہنی سپورٹرز کے لئے کوئی گنجائش نہیں ہے لہذا ایسے اشخاص بالکل بھی گروپ جوائن کرنے کی زحمت نہ کریں۔ معلوم ہونے پر فوراً ریموو کر دیا جائے گا۔

- تمام کتب انٹرنیٹ سے تلاش / ڈاؤنلوڈ کر کے **فری آف کاسٹ** وٹس ایپ گروپ میں شیئر کی جاتی ہیں۔ جو کتاب نہیں ملتی اس کے لئے معذرت کر لی جاتی ہے۔ جس میں محنت بھی صَرف ہوتی ہے لیکن ہمیں آپ سے صرف دعاؤں کی درخواست ہے۔
- عمران سیریز کے شوقین کیلئے علیحدہ سے عمران سیریز گروپ موجود ہے۔

لیڈیز کے لئے الگ گروپ کی سہولت موجود ہے جس کے لئے ویریفیکیشن ضروری ہے۔

- اردو کتب / عمران سیریز یا سٹڈی گروپ میں ایڈ ہونے کے لئے ایڈمن سے وٹس ایپ پر بذریعہ میسج رابطہ کریں اور جواب کا انتظار فرمائیں۔ برائے مہربانی اخلاقیات کا خیال رکھتے ہوئے موبائل پر کال یا ایم ایس کرنے کی کوشش ہرگز نہ کریں۔ ورنہ گروپس سے تو ریموو کیا ہی جائے گا بلاک بھی کیا جائے گا۔

محمد سلمان سلیم	پاکستان زندہ باد	راؤاماز
0306-7163117	0343-7008883	0333-8033313

اللہ تبارک تعالیٰ ہم سب کا حامی وناصر ہو

ii. Define chemical equilibrium?
iii. Why chemical equilibrium is a dynamic equilibrium?
iv. What is the importance of Haber process?
v. What is the importance of contact process?
vi. In the following flow diagram concentration of which species are taken in the numerator in the K_c expression? Where the co-efficient of balanced chemical equation are shown in K_c expression?
vii. Describe the macroscopic characteristics of an equilibrium reaction.

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q.4 Define law of mass action and derive expression for the equilibrium constant?

Q.5 a. For which of the following reactions are both reactants and products likely to be found when the reaction appears to be complete. Explain.

(i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ (ii) $2HF_{(g)} \rightleftharpoons H_{2(g)} + F_{2(g)}$

b. Define reversible reactions. Give examples.

Q.6 a. What happens when SO_2 and O_2 gases are mixed in a sealed container?

b. Define equilibrium constant?

SOLUTION OF GUESS PAPER & MODEL PAPER # 1
(Reduced Syllabus)

SECTION- A (MCQs)

i. D	ii. D	iii. D	iv. D	v. D	vi. A
vii. C	viii. C	ix. D	x. D	xi. A	xii. D

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

i. Differentiate between forward and reverse reactions.

Ans: Difference between forward and reverse reactions:

Forward Reaction	Reverse reactions
i. It is written from left to right.	i. It is written from right to left
ii. Reactants produce products.	ii. Products produce reactants.
iii. Rate is fastest in the beginning and gradually slows down	iii. Its rate is zero in the beginning and gradually speeds up.

ii. What is chemical equilibrium?

Ans: Chemical equilibrium:

A state of a chemical reaction in which forward and reverse reactions take place at the same rate is called chemical equilibrium.

iii. Write the law of Mass Action.

Ans: Law of Mass Action:

Two chemists C.M Guldberg and P. Waage in 1864 proposed the law of mass action to describe the equilibrium state.

iv. Write both forward and reverse reactions?

a. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

b. $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

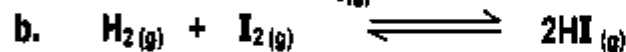
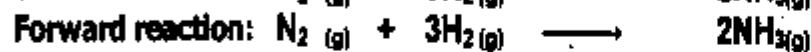
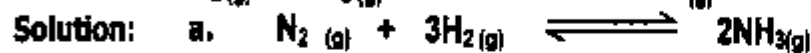
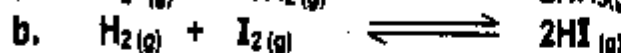
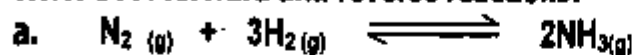
Solution: a. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

Forward reaction: $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$

Reverse reaction: $2NH_{3(g)} \longrightarrow N_{2(g)} + 3H_{2(g)}$

b. $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

Forward reaction: $H_{2(g)} + I_{2(g)} \longrightarrow 2HI_{(g)}$

Reverse reaction: $2HI_{(g)} \longrightarrow H_{2(g)} + I_{2(g)}$

v. What is the importance of equilibrium constant for a chemical reaction?

Ans: Importance of Equilibrium Constant:

(a) Determine the equilibrium concentration of equilibrium mixture knowing the initial concentration of reactants.

(b) Predict the direction of a chemical reaction.

(c) Predict the extent of a chemical reaction.

(d) Predict the effect of change in conditions of the chemical reaction on the equilibrium state.

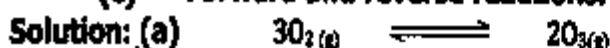
vi. Following reaction can occur during lightning storms $3O_{2(g)} \rightleftharpoons 2O_{3(g)}$

For this reaction write

(a) **Equilibrium constant expression.**

(b) **Determine the units of equilibrium constant.**

(c) **Forward and reverse reactions.**

Solution: (a) $3O_{2(g)} \rightleftharpoons 2O_{3(g)}$

$$K_c = \frac{[O_3]^2}{[O_2]^3}$$

(b) $$K_c = \frac{[O_3]^2}{[O_2]^3} = \frac{[\text{mole.dm}^{-3}]^2}{[\text{mole.dm}^{-3}]^3} = [\text{mole.dm}^{-3}]^{-1} = \text{mole}^{-1}\text{dm}^3$$

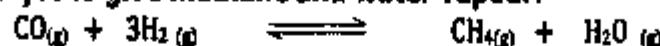
(c) **Forward reaction:** $3O_{2(g)} \longrightarrow 2O_{3(g)}$

Reverse reaction: $2O_{3(g)} \longrightarrow 3O_{2(g)}$

vii. Coal reacts with hot steam to form CO and H_2. These substances react further in the presence of a catalyst to give methane and water vapour.

$$CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$$

(a) **Write forward and reverse reactions for it.**

(b) **Derive K_c expression for the reaction.**

(c) **Determine units for K_c**

Solution: (a) **Forward reaction:** $CO_{(g)} + 3H_{2(g)} \longrightarrow CH_{4(g)} + H_2O_{(g)}$

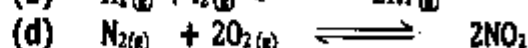
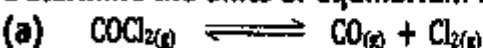
Reverse reaction: $CH_{4(g)} + H_2O_{(g)} \longrightarrow CO_{(g)} + 3H_{2(g)}$

(b) $$K_c = \frac{[CH_4][H_2O]}{[CO][H_2]^3}$$

(c) $CO_{(g)} + 3H_{2(g)} \rightleftharpoons CH_{4(g)} + H_2O_{(g)}$

$$K_c = \frac{[CH_4][H_2O]}{[CO][H_2]^3} = \frac{[\text{mole.dm}^{-3}][\text{mole.dm}^{-3}]}{[\text{mole.dm}^{-3}][\text{mole.dm}^{-3}]} = \text{no units}$$

Note: K_c has no unit when the total number of moles of reactants is equal to the total number of moles of products in a balanced chemical equation.

viii. Determine the units of equilibrium constants for the following reactions.

(a) $COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)}$ (b) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

(c) $2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)}$ (d) $N_{2(g)} + 2O_{2(g)} \rightleftharpoons 2NO_2$

Solution: (a) $COCl_{2(g)} \rightleftharpoons CO_{(g)} + Cl_{2(g)}$

(b) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

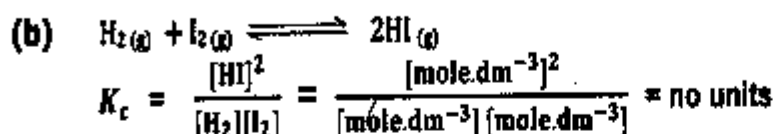
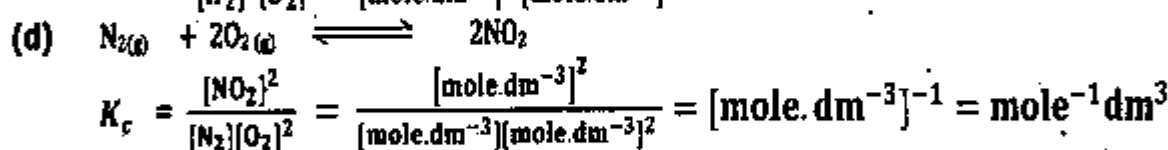
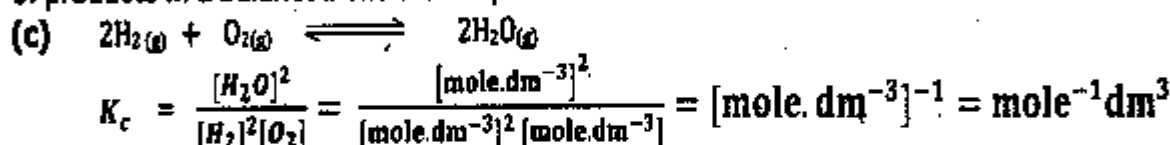
$$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{[mole.dm^{-3}]^2}{[mole.dm^{-3}][mole.dm^{-3}]} = \text{no units}$$

K_c has no unit when the total number of moles of reactants is equal to the total number of moles of products in a balanced chemical equation.

(c) $2H_{2(g)} + O_{2(g)} \rightleftharpoons 2H_2O_{(g)}$

$$K_c = \frac{[H_2O]^2}{[H_2]^2[O_2]} = \frac{[mole.dm^{-3}]^2}{[mole.dm^{-3}]^2[mole.dm^{-3}]} = [mole.dm^{-3}]^{-1} = mole^{-1}dm^3$$

(d) $N_{2(g)} + 2O_{2(g)} \rightleftharpoons 2NO_2$

$$K_c = \frac{[NO_2]^2}{[N_2][O_2]^2} = \frac{[mole.dm^{-3}]^2}{[mole.dm^{-3}][mole.dm^{-3}]^2} = [mole.dm^{-3}]^{-1} = mole^{-1}dm^3$$

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

i. Define equilibrium mixture?

Ans: Equilibrium mixture:

The concentrations of reactants and products are called equilibrium concentrations and the mixture is

ii. Define chemical equilibrium?

Ans: Chemical equilibrium:

A state of a chemical reaction in which forward and reverse reactions take place at the same rate is called chemical equilibrium.

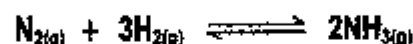
iii. Why chemical equilibrium is a dynamic equilibrium?

Ans: Dynamic equilibrium:

Chemical equilibrium is a dynamic equilibrium. This is because reactions do not stop when they come to equilibrium state. The individual molecules keep on reacting continuously. But there is no change in the actual amounts of reactants and products. This means concentrations of reactants and products become constant at equilibrium stage.

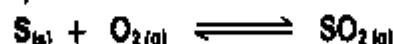
iv. What is the importance of Haber process?

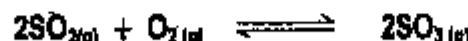
Ans: Ammonia is produced by the reaction of nitrogen with hydrogen at **450° C**, 200 atm pressure and in the presence of a catalyst.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

This is known as Haber process. This is a reversible process and produces only 33% NH_3 at equilibrium. The high pressure is used to favour the formation of ammonia. Then, cooling the equilibrium mixture gives 98% ammonia.

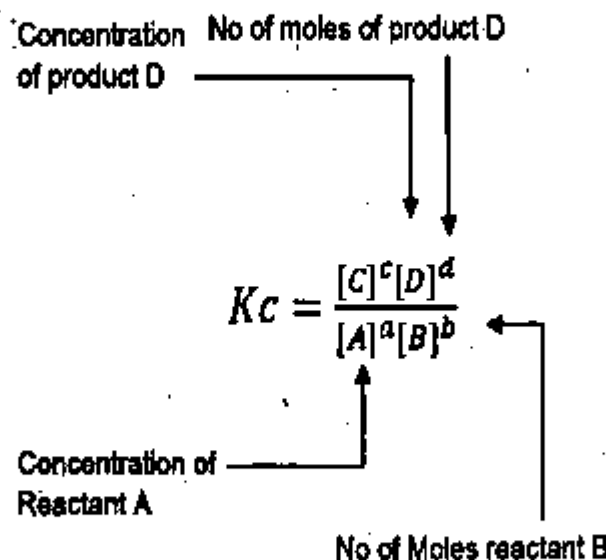
v. What is the importance of contact process?

Ans: Sulphuric acid is produced on the large scale by the contact process. In this process sulphur in converted into sulphur dioxide.

$$S_{(s)} + O_{2(g)} \rightleftharpoons SO_{2(g)}$$

Sulphur dioxide is purified and further oxidized at 450°C and 200 atm pressures in the presence of Pt or V_2O_5 as catalyst.

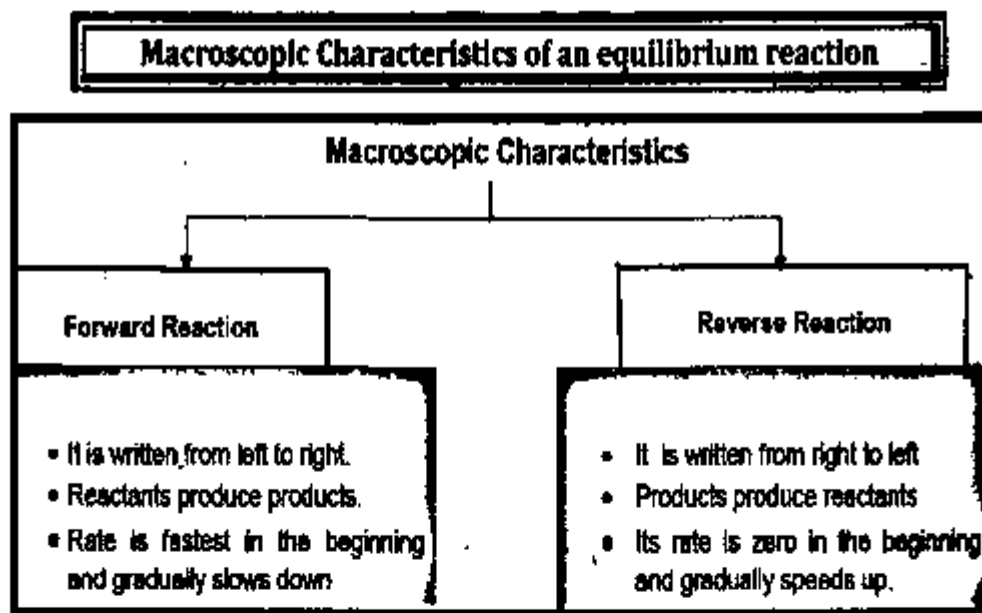
$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

This reaction is a reversible reaction. Here again by the application of principles of chemical

vi. **In the following flow diagram concentration of which species are taken in the numerator in the K_c expression? Where the co-efficient of balanced chemical equation are shown in K_c expression?**

$$Kc = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Ans: Concentration of products is taken in the numerator and concentration of reactants in the denominator.

Coefficient of balance chemical equation (a, b, c, d indicates number of moles of A, B, C, D) are shown in k_c as the raised to the power of the concentration of products and reactants.

vii. **Describe the macroscopic characteristics of an equilibrium reaction.**

Ans:

Macroscopic Characteristics of an equilibrium reaction

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. **(2 × 10 = 20)**

Q.4 Define law of mass action and derive expression for the equilibrium constant?

Ans: Law of Mass Action:

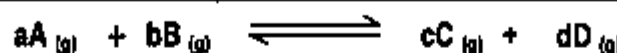
Two chemists C.M Guldberg and P. Waage in 1864 proposed the law of mass action to describe the equilibrium state.

It states that the rate at which a substance reacts is directly proportional to its active mass and the rate at which the reaction proceeds is directly proportional to the product of the active masses of the reactants.

Active mass:

The term "active mass" represents the concentration of reactants and products in **moles.dm^{-3}** for a dilute solution, and is expressed in terms of square brackets [ ].

Derivation of the Expression for the Equilibrium Constant:

$$aA_{(g)} + bB_{(g)} \rightleftharpoons cC_{(g)} + dD_{(g)}$$

According to the law of mass action;

Rate of forward reaction $\propto [A]^a [B]^b$ Rate of forward reaction $= k_f [A]^a [B]^b$

Rate of reverse reaction $\propto [C]^c [D]^d$ Rate of reverse reaction $= k_r [C]^c [D]^d$

Where k_f and k_r are the rate constants for forward and the reverse reactions respectively

At equilibrium state: Rate of forward reaction = Rate of reverse reaction Thus,

$$k_f [A]^a [B]^b = k_r [C]^c [D]^d$$

$$\frac{k_f}{k_r} = \frac{[C]^c[D]^d}{[A]^a[B]^b} \Rightarrow K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Equilibrium constant:

Where $K_c = \frac{k_f}{k_r}$ and is known as equilibrium constant, and the above equation is known as equilibrium constant expression. The square brackets indicate the concentration of the chemical species at equilibrium in **moles.dm^{-3}**.

Q.5 a. For which of the following reactions are both reactants and products likely to be found when the reaction appears to be complete. Explain.

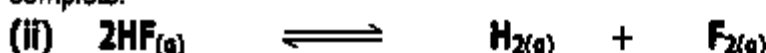
(i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ **(ii)** $2HF_{(g)} \rightleftharpoons H_{2(g)} + F_{2(g)}$

Solution:

(i) $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$

In this reaction carbon reacts with oxygen to form carbon dioxide. This reaction is irreversible reaction because it takes place in one direction only. In irreversible reaction the tendency of reverse reaction is negligible.

Therefore both reactants and products are not likely to be found when the reaction appears to be complete.

(ii) $2HF_{(g)} \rightleftharpoons H_{2(g)} + F_{2(g)}$

This reaction indicates decomposition of HF into H_2 and F_2. In this reaction forward as well as reverse reactions occur to a measureable extent.

Forward reaction: $2HF_{(g)} \longrightarrow H_{2(g)} + F_{2(g)}$

Reverse reaction: $H_{2(g)} + F_{2(g)} \longrightarrow 2HF_{(g)}$

Therefore reaction number (ii) appears to be complete.

A chemical reaction is in equilibrium when there is no tendency for the quantities of reactants and products to change.

The **direction** in which we write a chemical reaction (and thus which components are considered reactants and which are products) is arbitrary.

Thus the two equations

$H_2 + I_2 \longrightarrow 2HI$ **"synthesis of hydrogen iodide"**

$2HI \longrightarrow H_2 + I_2$ **"dissociation of hydrogen iodide"**

represent the same chemical reaction system in which the roles of the components are reversed, *and both yield the same mixture of components when the change is completed.*

b. Define reversible reactions. Give examples.

Ans: Reversible reaction:

A reaction in which the products can react together to reform the original reactant is called reversible reaction.

OR

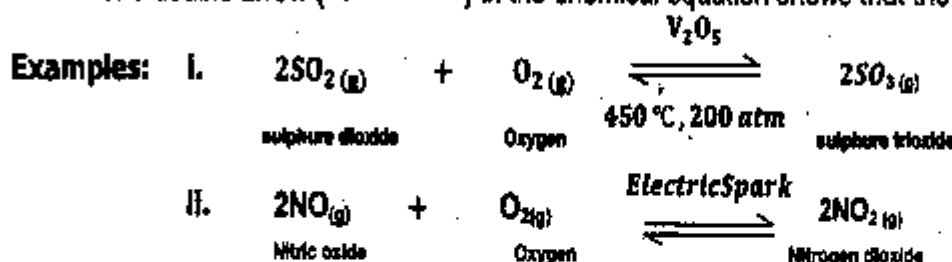
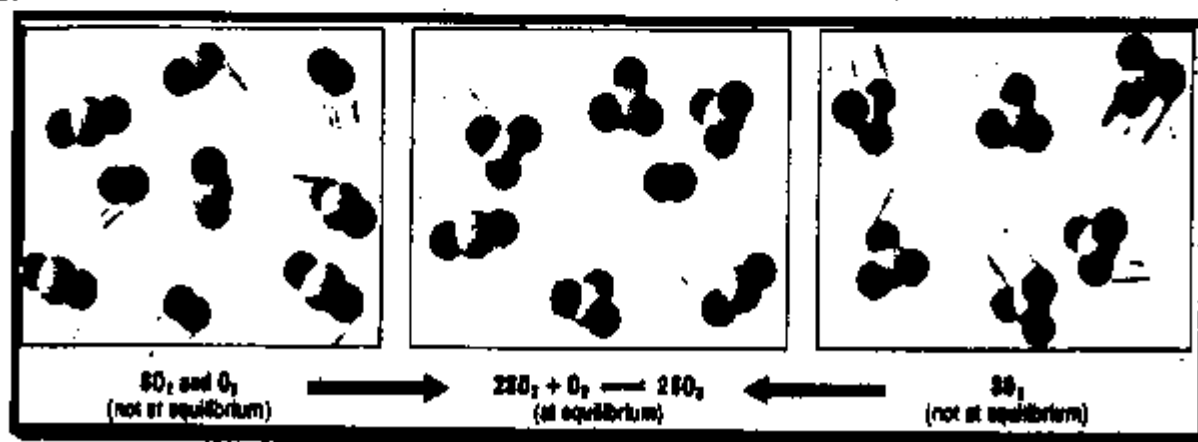
A reaction which proceeds in the forward direction as well as in the reverse direction under the same conditions is called a reversible reaction.

Properties of reversible reaction:

Notation of reversible reaction:

The double arrow ($\rightleftharpoons$) in the chemical equation shows that the reaction is reversible.

Examples: i. $2SO_{2(g)} + O_{2(g)} \underset{450\,°C,\ 200\ atm}{\overset{V_2O_5}{\rightleftharpoons}} 2SO_{3(g)}$
sulphure dioxide, Oxygen, sulphure trioxide

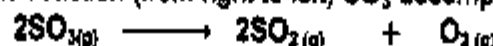
ii. $2NO_{(g)} + O_{2(g)} \overset{Electric Spark}{\rightleftharpoons} 2NO_{2(g)}$
Nitric oxide, Oxygen, Nitrogen dioxide

Q.6 a. What happens when SO_2 and O_2 gases are mixed in a sealed container?
Ans:

Reaction between SO_2 and O_2

Molecules of SO_2 and O_2 react to give SO_3. Molecules of SO_3 decompose to give SO_2 and O_2.

Forward reaction: In the first reaction (from left to right) SO_2 and O_2 produce SO_3.

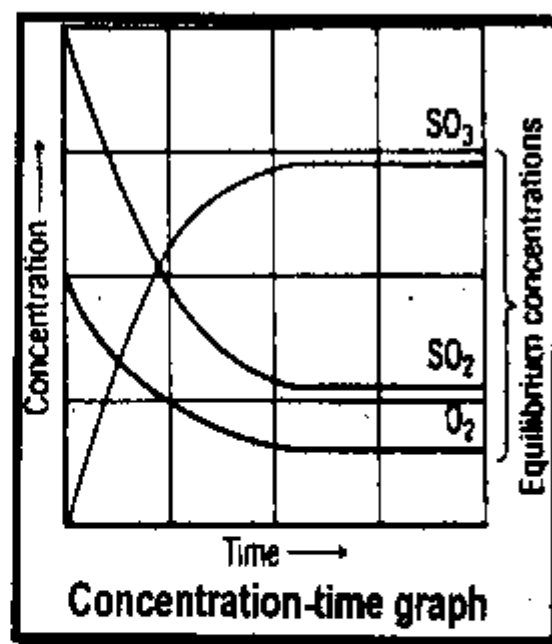
$$2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$$

Reverse reaction: In the second reaction (from right to left) SO_3 decompose into SO_2 and O_2.

$$2SO_{3(g)} \longrightarrow 2SO_{2(g)} + O_{2(g)}$$

Equilibrium state:

As the concentration of SO_3 becomes higher, the reverse reaction speeds up.

Eventually the two rates become equal. At this stage SO_3 decomposes to SO_2 and O_2 as fast as SO_2 and O_2 produce SO_3. At this stage reaction is said to have reached equilibrium state.

Concentration-time graph

b. Define equilibrium constant?

Ans: Equilibrium constant (K_c):

Equilibrium constant is defined as the ratio of the product of concentration of products to the product of

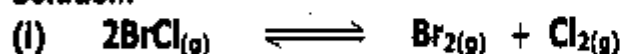
$$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

K_c is independent of the initial concentrations of reactants but depends upon temperature.

Important Questions & Answers (Reduced Syllabus)

Q1. Bromine chloride (BrCl) decomposes to form chlorine and bromine. For this reaction write.
(i) Chemical equation (ii) K_c expression
(iii) Units of K_c

Solution:

(i) $2BrCl_{(g)} \rightleftharpoons Br_{2(g)} + Cl_{2(g)}$

(ii) $K_c = \frac{[Br_2][Cl_2]}{[BrCl]^2}$

(iii) $K_c = \frac{[Br_2][Cl_2]}{[BrCl]^2} = \frac{[mole.dm^{-3}][mole.dm^{-3}]}{[mole.dm^{-3}]^2} = \text{no units}$

Self-Assessment Exercise 9.3

Determine the units of equilibrium constants for the following reactions.

1. $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$
2. $H_{2(g)} + CO_{2(g)} \rightleftharpoons H_2O_{(g)} + CO_{(g)}$
3. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$
4. $CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$

Solution:

1. $N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

$$K_c = \frac{[NO]^2}{[N_2][O_2]} = \frac{[mole.dm^{-3}]^2}{[mole.dm^{-3}][mole.dm^{-3}]} = \text{no units}$$

Note: K_c has no unit when the total number of moles of reactants is equal to the total number of moles of products in a balanced chemical equation.

2. $H_{2(g)} + CO_{2(g)} \rightleftharpoons H_2O_{(g)} + CO_{(g)}$

$$K_c = \frac{[H_2O][CO]}{[H_2][CO_2]} = \frac{[mole.dm^{-3}][mole.dm^{-3}]}{[mole.dm^{-3}][mole.dm^{-3}]} = \text{no units}$$

Note: K_c has no unit when the total number of moles of reactants is equal to the total number of moles of products in a balanced chemical equation.

3. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{[mole.dm^{-3}][mole.dm^{-3}]}{[mole.dm^{-3}]} = [mole.dm^{-3}]$$

4. $CO_{(g)} + 2H_{2(g)} \rightleftharpoons CH_3OH_{(g)}$

$$K_c = \frac{[CH_3OH]}{[CO][H_2]^2} = \frac{[mole.dm^{-3}]}{[mole.dm^{-3}][mole.dm^{-3}]^2} = [mole.dm^{-3}]^{-2} = mole^{-2}.dm^6$$

GUESS PAPER & MODEL PAPER # 02
BASED ON CHAPTER # 10 (Reduced Syllabus)
ACIDS BASES AND SALTS

CHAPTER 10 : **ACID, BASES AND SALTS**

Topics: Concept of Acid and bases, Arrhenius, Lowry and Bronsted-Lowery, Lewis concept of acid and bases, pH scale, Salts, Uses of salts.

Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

(i) Which of the following cannot be classified as Arrhenius acid?
A. HNO_3 B. H_2CO_3 C. CO_2 D. H_2SO_4

(ii) NH_3 cannot be classified as a base by
A. Lewis theory B. Bronsted -Lowry theory
C. Arrhenius theory D. All of these theories

(iii) Which of the following is a Lewis base?
A. BF_3 B. HCl C. $AlCl_3$ D. F^-

(iv) Choose Lewis acid
A. CN^- B. $\ddot{N}H_3$ C. $H_2\ddot{O}$: D. H^+

(v) A drain cleaner solution contains 1.0×10^{-8} M, OH^- concentration. This Solution is
A. acidic B. basic C. neutral D. cannot be predicted

(vi) Milk of magnesia contains $Mg(OH)_2$. It is used as antacid. It neutralizes excess stomach acid. Which salt is formed in this reaction?
A. $MgSO_4$ B. $MgCO_3$ C. $MgCl_2$ D. MgO

(vii) Ammonia is a base, because it
A. Ionizes in water to give OH^- ions B. Contains OH group
C. Can accept an election pair D. Can accept proton

(viii) Consider the following reaction?
$H_2O + HCl \rightleftharpoons H_3O^+ + Cl^-$
Which species is an electron pair acceptor in this reaction?
A. H_2O B. HCl C. H_3O^+ D. none

(ix) In the following reaction which species is donating an electron pair?
$NH_3 + BF_3 \longrightarrow H_3N - BF_3$
A. H B. B C. N D. BF_3

(x) An aqueous solution of NaOH is used as a drain cleaner. If the concentration of OH^- ions in

(xi) In ______ a Swedish chemist Svante Arrhenius proposed the first successful theory of acids and bases.
A. 1887 B. 1886 C. 1884 D. 1885

(xii) $K_w = K_c [H_2O]$ is called ionization constant for water.
A. dissociation constant B. ionization constant
C. rate constant D. equilibrium constant

CHEMISTRY SSC-II

Time allowed: 2:40 hours Total Marks: [illegible]

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

i. Write the uses of some common acids?
ii. Define and give examples of Arrhenius acids.
iii. Why H^+ ion acts as a Lewis acid?
iv. Why NH_3 acts as Bronsted-Lowry base?
v. Why BF_3 acts as Lewis acid?
vi. Ammonium hydroxide and nitric acid react and produce ammonium nitrate and water. Write balanced chemical equation for this neutralization reaction.
vii. Write balanced chemical equations for the following neutralization reactions.
(i) Sulphuric acid + Magnesium hydroxide ⟶ magnesium sulphate + water.
(ii) Sulphuric acid + Sodium hydroxide ⟶ Soduim sulphate + water.
(iii) Hydrochloric acid + calcium hydroxide ⟶ calcium chloride + water
viii. Identify Lewis acid and Lewis base in the following reactions.
(i) $F^- + BF_3 \longrightarrow [BF_4]^-$ (ii) $H^+ + NH_3 \longrightarrow [NH_4]^-$
(iii) $NH_3 + AlCl_3 \longrightarrow [H_3N-AlCl_3]$

SECTION – C (Marks 15)

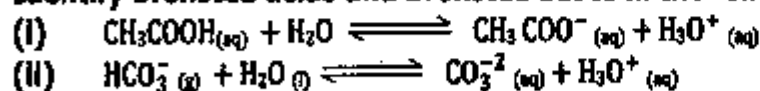
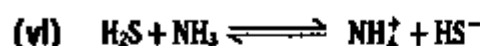
Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

i. Write equations showing the ionization of the following as Bronsted-Lowry acids.
(a) $HNO_{2\,(aq)}$ (b) $HCN_{(aq)}$
ii. Write the uses of some common bases?
iii. Identify the Lewis acids and the Lewis bases in the following reactions.
(i) $Ag^+_{(aq)} + 2CN^-_{(aq)} \longrightarrow Ag(CN_2)_{(aq)}$ (ii) $B(OH)_{3\,(s)} + OH^-_{(aq)} \longrightarrow B(OH)^-_{4\,(aq)}$
(iii) $Cu^{+2}_{(aq)} + 4NH_{3(aq)} \longrightarrow [Cu(NH_3)_4]^{+2}$ (iv) $OH^-_{(aq)} + Al(OH)_{3(s)} \longrightarrow Al(OH)^-_{4\,(aq)}$
iv. Give the Arrhenius concept of acids and bases. Write an equation that illustrates the definition.
v. What are the limitations of Arrhenius theory?
vi. List the substances that cannot be explained by Arrhenius theory or the Bronsted-Lowry theory?
vii. What do you meant by pH scale?

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q4. Identify Bronsted acids and Bronsted bases in the following reactions.
(i) $CH_3COOH_{(aq)} + H_2O \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$
(ii) $HCO^-_{3\,(s)} + H_2O_{(l)} \rightleftharpoons CO^{-2}_{3\,(aq)} + H_3O^+_{(aq)}$

(vi) $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

Q5. a. What do you know about salts? OR Define salt and write its composition?

b. Highlight some characteristic properties of acids and bases?

Q6. Give the Lewis definition of an acid and a base. Write an equation that illustrates the definition.

SOLUTION OF GUESS PAPER & MODEL PAPER # 2
(Reduced Syllabus)

SECTION- A (MCQs)

i. C	ii. C	iii. D	iv. D	v. A	vi. C
vii. D	viii. B	ix. C	x. C	xi. A	xii. B

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

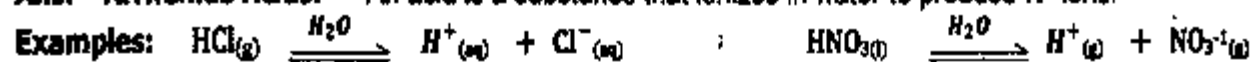
i. Write the uses of some common acids?

Ans: Uses of common acids:

Name	Formula	Common use
Hydrochloric acid	HCl	Cleaning of metals, bricks and removing scale from boilers
Nitric acid	HNO_3	Manufacture of fertilizers, explosives
Sulphuric acid	H_2SO_4	Manufacture of many chemicals, drugs, dyes, paints and explosives.
Phosphoric acid	H_3PO_4	Manufacture of fertilizers, acidulant for food.

ii. Define and give examples of Arrhenius acids.

Ans: Arrhenius Acids: An acid is a substance that ionizes in water to produce H^+ ions.

Examples: $HCl_{(g)} \xrightleftharpoons{H_2O} H^+_{(aq)} + Cl^-_{(aq)}$; $HNO_{3(l)} \xrightleftharpoons{H_2O} H^+_{(aq)} + NO_3^{-1}{}_{(aq)}$

iii. Why H^+ ion acts as a Lewis acid?

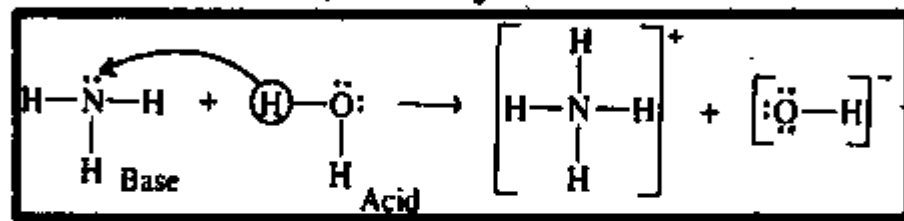
Ans: A lewis acid is a lone pair acceptor, the H^+ ion has no electrons, so can easily accept a lone pair from another atom. That is why H^+ ion acts as a Lewis acid.

iv. Why NH_3 acts as Bronsted-Lowry base?

Ans: Ammonia acts as a base in water:

Bronsted-Lowry theory explains how ammonia acts as a base in water. Ammonia is a gas at room temperature. When it is dissolved in water, the following reaction occurs.

$$H-\ddot{N}(H)-H + H-\ddot{O}(H): \longrightarrow [H-N(H)(H)-H]^+ + [:\ddot{O}-H]^-$$

Base Acid

Water is proton donor and ammonia proton accepter. Therefore water acts as an acid and ammonia as a base.

v. Why BF_3 acts as Lewis acid?

Ans:

Boron in BF_3 has incomplete octet. It has six electrons (3 electron pairs).
So it needs an electron pair to complete its octet. Hence BF_3 is an electron pair accepter or Lewis acid.

vi. Ammonium hydroxide and nitric acid react and produce ammonium nitrate and water. Write balanced chemical equation for this neutralization reaction.

Ans: $NH_4OH + HNO_3 \longrightarrow NH_4NO_3 + H_2O$

vii. Write balanced chemical equations for the following neutralization reactions.

(i) Sulphuric acid + Magnesium hydroxide ⟶ magnesium sulphate + water.
(ii) Sulphuric acid + Sodium hydroxide ⟶ Soduim sulphate + water.
(iii) Hydrochloric acid + calcium hydroxide ⟶ calcium chloride + water

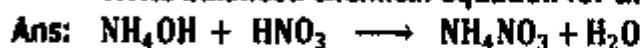
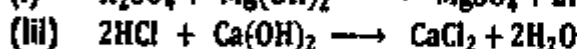
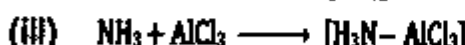
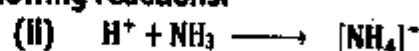
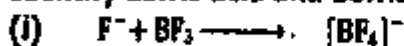
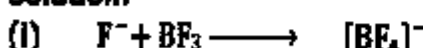
Solution:

(i) $H_2SO_4 + Mg(OH)_2 \longrightarrow MgSO_4 + 2H_2O$ (ii) $H_2SO_4 + 2NaOH \longrightarrow Na_2SO_4 + 2H_2O$
(iii) $2HCl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O$

viii. Identify Lewis acid and Lewis base in the following reactions.

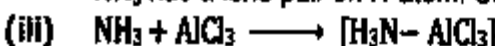
(i) $F^- + BF_3 \longrightarrow [BF_4]^-$ (ii) $H^+ + NH_3 \longrightarrow [NH_4]^-$
(iii) $NH_3 + AlCl_3 \longrightarrow [H_3N-AlCl_3]$

Solution:

(i) $F^- + BF_3 \longrightarrow [BF_4]^-$

F^- has a lone pair on F-atom. So it is electron pair donor. F^- is a Lewis base.
Boron in BF_3 has incomplete octet. It has six electrons (3 electron pairs).
So it needs an electron pair to complete its octet. Hence BF_3 is an electron pair accepter or Lewis acid.

(ii) $H^+ + NH_3 \longrightarrow [NH_4]^-$

A lewis acid is a lone pair acceptor, the H^+ ion has no electrons, so can easily accept a lone pair from another atom. That is why H^+ ion acts as a Lewis acid.
NH_3 has a lone pair on N-atom. So it is electron pair donor. NH_3 is a Lewis base.

(iii) $NH_3 + AlCl_3 \longrightarrow [H_3N-AlCl_3]$

In $AlCl_3$ Aluminium (Al) is deficient of two electrons. Therefore, it will be called Lewis acid NH_3 contains a lone pair and can be donated to $AlCl_3$. Hence H_3N: will act as Lewis Bases.

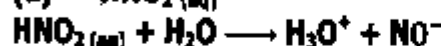
SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

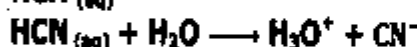
i. Write equations showing the ionization of the following as Bronsted-Lowry acids.

(a) $HNO_{2\,(aq)}$ (b) $HCN_{(aq)}$

Solution: (a) $HNO_{2\,(aq)}$

$HNO_{2\,(aq)} + H_2O \longrightarrow H_3O^+ + NO^-$

Since HNO_2 is converted to NO^- by donating proton therefore HNO_2 is an acid.
Since H_2O accepts the proton that HNO_2 donates and forms H_3O^+, water is a base.

(b) $HCN_{(aq)}$

$HCN_{(aq)} + H_2O \longrightarrow H_3O^+ + CN^-$

Since HCN is converted to CN^- by donating proton therefore HCN is an acid.
Since H_2O accepts the proton that HCN donates and forms H_3O^+, water is a base.

ii. Write the uses of some common bases?

Ans: Uses of common bases:

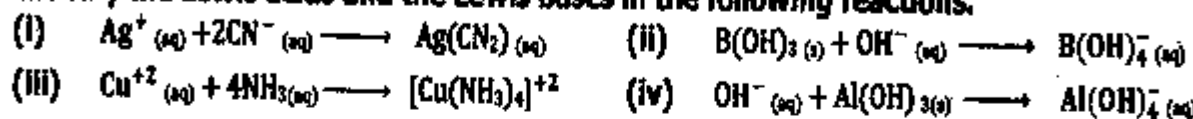
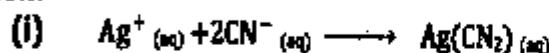
Name	Formula	Common use
Sodium hydroxide	NaOH	Soap making, drain cleaners
Potassium hydroxide	KOH	Making liquid soap, shaving cream

iii. Identify the Lewis acids and the Lewis bases in the following reactions.

(i) $Ag^+_{(aq)} + 2CN^-_{(aq)} \longrightarrow Ag(CN_2)_{(aq)}$ (ii) $B(OH)_{3(s)} + OH^-_{(aq)} \longrightarrow B(OH)^-_{4(aq)}$

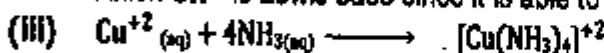
(iii) $Cu^{+2}_{(aq)} + 4NH_{3(aq)} \longrightarrow [Cu(NH_3)_4]^{+2}$ (iv) $OH^-_{(aq)} + Al(OH)_{3(s)} \longrightarrow Al(OH)^-_{4(aq)}$

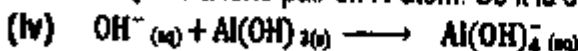
Solution:

(i) $Ag^+_{(aq)} + 2CN^-_{(aq)} \longrightarrow Ag(CN_2)_{(aq)}$

Cation Ag^+ is Lewis acid since it is able to accept electrons.
Anion CN^- is Lewis base since it is able to donate electrons.

(ii) $B(OH)_{3(s)} + OH^-_{(aq)} \longrightarrow B(OH)^-_{4(aq)}$

$B(OH)_3$ is Lewis acid since it is able to accept electrons.
Anion OH^- is Lewis base since it is able to donate electrons.

(iii) $Cu^{+2}_{(aq)} + 4NH_{3(aq)} \longrightarrow [Cu(NH_3)_4]^{+2}$

Cation Cu^{+2} is Lewis acid since it is able to accept electrons.
NH_3 has a lone pair on N-atom. So it is electron pair donor. NH_3 is a Lewis base.

(iv) $OH^-_{(aq)} + Al(OH)_{3(s)} \longrightarrow Al(OH)^-_{4(aq)}$

$Al(OH)_3$ is Lewis acid since it is able to accept electrons.
Anion OH^- is Lewis base since it is able to donate electrons.

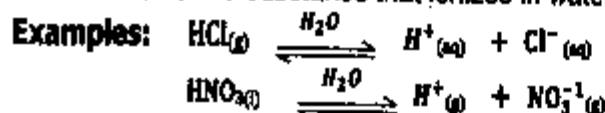
iv. Give the Arrhenius concept of acids and bases. Write an equation that illustrates the definition.

Ans: Arrhenius Concept of Acids and Bases:

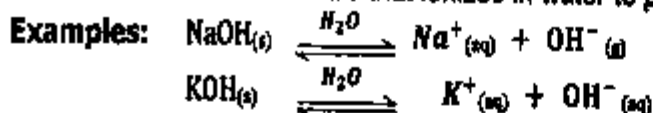
In 1887, a Swedish chemist Svante Arrhenius proposed the first successful theory of acids and bases.

Acid: An acid is a substance that ionizes in water to produce H^+ ions.

Examples: $HCl_{(g)} \xrightleftharpoons{H_2O} H^+_{(aq)} + Cl^-_{(aq)}$

$HNO_{3(l)} \xrightleftharpoons{H_2O} H^+_{(l)} + NO_3^{-1}{}_{(l)}$

Base: A base is a substance that ionizes in water to produces OH^- ions.

Examples: $NaOH_{(s)} \xrightleftharpoons{H_2O} Na^+_{(aq)} + OH^-_{(l)}$

$KOH_{(s)} \xrightleftharpoons{H_2O} K^+_{(aq)} + OH^-_{(aq)}$

v. What are the limitations of Arrhenius theory?

Ans: Limitations of Arrhenius theory:

Arrhenius theory has its limitations. It applies to aqueous solutions. It does not explain why compounds such as CO_2, SO_2 etc., are acids. Why substances like NH_3, are bases? There is no H in CO_2 and OH in NH_3.

Dissatisfaction of Arrhenius theory (Defects):

i. There are certain substances which do not give H^{+1} ions but still they are acidic in solution e.g. $AlCl_3$.
ii. There are substances which do not give OH^{-1} ions in H_2O but are basic in nature e.g. NH_3.

vi. List the substances that cannot be explained by Arrhenius theory or the Bronsted-Lowry theory?

Ans: Certain substances like SO_2, CO_2, CaO, BF_3 etc. behave as acids or bases although they do not have ability to donate or accept protons. Nature of such substances cannot be explained by Arrhenius theory or the Bronsted-Lowry theory.

vii. What do you meant by pH scale?

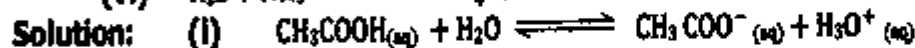
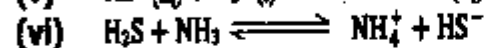
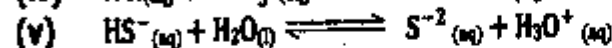
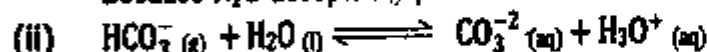
Ans: The pH scale:

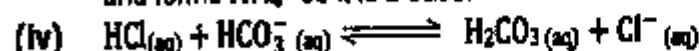
Chemists use a number scale from 0 to 14 to describe the concentration of H^+ ions in a solution. It is known as pH scale.

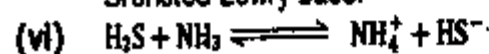
i. A pH of 7 indicates a neutral solution.
ii. Acids have pH less than 7.
iii. Bases have pH greater than 7.

SECTION – D (Marks 20)

(ii) $HCO_3^-{}_{(g)} + H_2O_{(l)} \rightleftharpoons CO_3^{-2}{}_{(aq)} + H_3O^+{}_{(aq)}$
(iii) $NH_{3(g)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$
(iv) $HCl_{(aq)} + HCO_3^-{}_{(aq)} \rightleftharpoons H_2CO_{3(aq)} + Cl^-{}_{(aq)}$
(v) $HS^-{}_{(aq)} + H_2O_{(l)} \rightleftharpoons S^{-2}{}_{(aq)} + H_3O^+{}_{(aq)}$
(vi) $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

Solution: (i) $CH_3COOH_{(aq)} + H_2O \rightleftharpoons CH_3COO^-{}_{(aq)} + H_3O^+{}_{(aq)}$

Because CH_3COOH is converted to CH_3COO^- by donating proton therefore CH_3COOH is an acid.
Because H_2O accepts the proton that CH_3COOH donates and forms H_3O^+ therefore water is a base.

(ii) $HCO_3^-{}_{(g)} + H_2O_{(l)} \rightleftharpoons CO_3^{-2}{}_{(aq)} + H_3O^+{}_{(aq)}$
The HCO_3^- loses an H^+ ion, so it is the Bronsted-Lowry acid. The H_2O gains the H^+ ion, so it is the Bronsted-Lowry base.

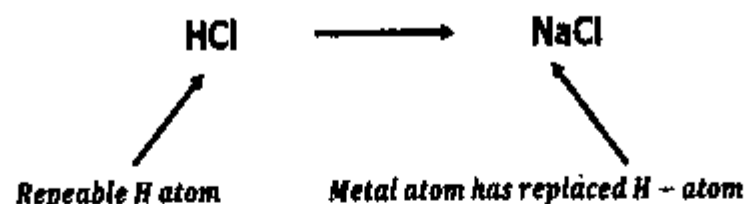
(iii) $NH_{3(g)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$
H_2O is converted to OH^- by donating a proton, so H_2O is an acid. Because NH_3 accepts the proton and forms NH_4^+ so it is a base.

(iv) $HCl_{(aq)} + HCO_3^-{}_{(aq)} \rightleftharpoons H_2CO_{3(aq)} + Cl^-{}_{(aq)}$
The HCl loses an H^+ ion, so it is the Bronsted-Lowry acid. The HCO_3^- gains the H^+ ion, so it is the Bronsted-Lowry base.

(v) $HS^-{}_{(aq)} + H_2O_{(l)} \rightleftharpoons S^{-2}{}_{(aq)} + H_3O^+{}_{(aq)}$
The HS^- loses an H^+ ion, so it is the Bronsted-Lowry acid. The H_2O gains the H^+ ion, so it is the Bronsted-Lowry base.

(vi) $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$
H_2S is donating a proton, so H_2S is an acid. Because NH_3 accepts the proton and forms NH_4^+ so it is a base.

Q5. a. What do you know about salts? OR Define salt and write its composition?

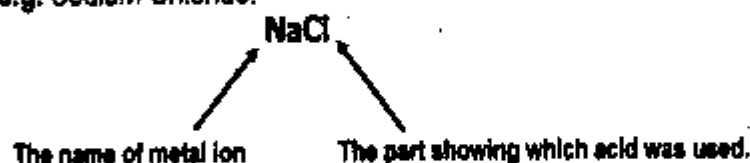
Ans: Salts:

An acid contains replaceable hydrogen atoms. When these are completely or partially replaced by metal atoms, a compound called salt is formed.

Example:

Properties of salts:

i. Salts are ionic compounds.
ii. The first part of the name is of the metal ion and second part of the name is of the negative part of the acid. e.g. Sodium Chloride.

NaCl

The name of metal ion — The part showing which acid was used.

b. Highlight some characteristic properties of acids and bases?

Ans: Some characteristic properties of acids and bases:

No.	Property	Acid	Base
1	Taste	Sour	Bitter
2	Effect on blue litmus	Turns red	No effect
3	Effect on red litmus	No effect	Turns blue

Q6. Give the Lewis definition of an acid and a base. Write an equation that illustrates the definition.

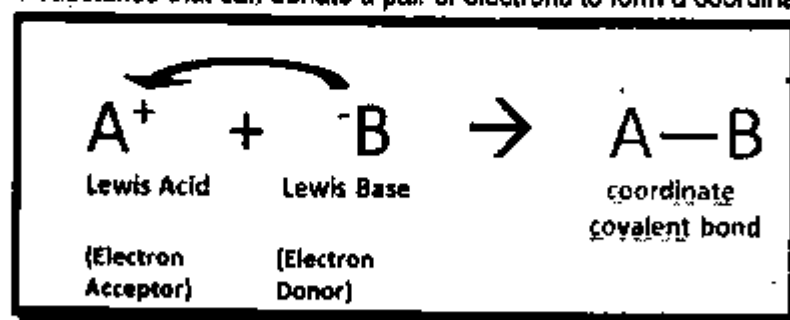
Ans: Lewis Concept of Acids and Bases:

In 1923, G.N Lewis proposed an acid base theory that focuses on reaction. This concept is more general than either the Arrhenius theory or the Bronsted-Lowery theory.

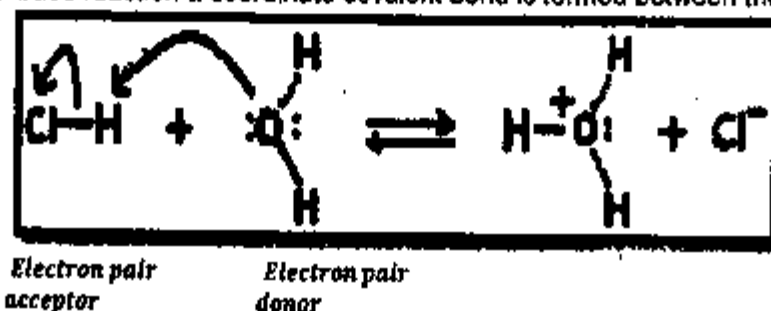
Lewis acid:

A Lewis acid is substance that can accept a pair of electrons to form a coordinate covalent bond.

Lewis base:

A Lewis base is substance that can donate a pair of electrons to form a coordinate covalent bond.

Examples:

In a Lewis acid-base reaction a coordinate covalent bond is formed between the acid and the base.

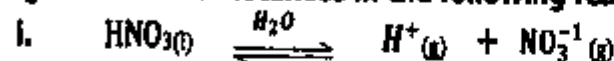
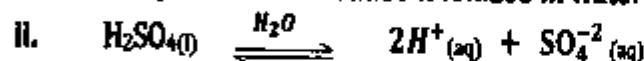
Electron pair acceptor *Electron pair donor*

In above example H_2O donates electron pair to HCl therefore H_2O is a base. Whereas HCl is an acid because it accepts an electron pair.

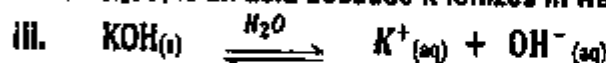
Important Questions & Answers (Reduced Syllabus)

Q1. Which substances in the following reactions are acids or bases?

i. $HNO_{3(l)} \xrightleftharpoons{H_2O} H^+_{(g)} + NO_3^{-1}{}_{(g)}$

Ans: **HNO_3 is an acid because it ionizes in water to produce H^+ ions.**

ii. $H_2SO_{4(l)} \xrightleftharpoons{H_2O} 2H^+_{(aq)} + SO_4^{-2}{}_{(aq)}$

Ans: **H_2SO_4 is an acid because it ionizes in water to produce H^+ ions.**

iii. $KOH_{(s)} \xrightarrow{H_2O} K^+_{(aq)} + OH^-_{(aq)}$

Ans: **KOH is base because it ionizes in water to produce OH^- ions.**

iv. $NH_4OH_{(l)} \xrightleftharpoons{H_2O} NH_4{}^+_{(aq)} + OH^-_{(aq)}$

Ans: **NH_4OH is base because it ionizes in water to produce OH^- ions.**

Q2. What are the limitations of Bronsted- Lowry concept?

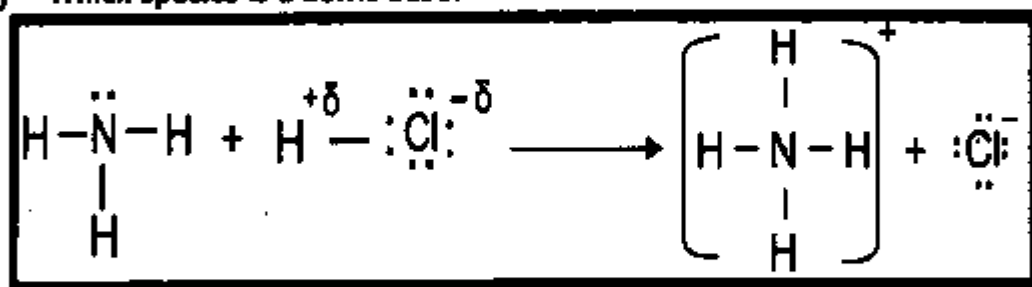
Ans: Dissatisfaction of Lowry Bronsted concept (Defects):

Bronsted-Lowry concept is also not so comprehensive because following this concept, certain compounds cannot be considered as acids or bases although they act as acids or bases. For example, sulphur trioxide (SO_3) is an acid but it cannot donate a proton. Similarly, calcium oxide (CaO) is a base but it cannot accept a proton.

Q6. Which substance is base? **Ans:** Substance which accepts proton is called acid.

Q7. Consider the following reactions.

(i) **Which species is donating an electron pair?**
(ii) **Which species is accepting an electron pair?**
(iii) **Which species is a Lewis acid?**
(iv) **Which species is a Lewis base?**

$$H-\ddot{N}(H)-H + H^{+\delta}-:\ddot{Cl}:^{-\delta} \longrightarrow [H-N(H)(H)-H]^+ + :\ddot{Cl}:^-$$

Solution:

(i) **Which species is donating an electron pair?**
Ans: Nitrogen atom in ammonia donates an electron pair to H-atom in HCl.
(ii) **Which species is accepting an electron pair?** **Ans: HCl**
(iii) **Which species is a Lewis acid?** **Ans: HCl**
(iv) **Which species is a Lewis base?** **Ans: NH_3**

Q8. At what pH phenolphthalein changes its colour?
Ans: Phenolphthalein, works in a pH range of 8.2 to 10.0. The colour change is from colourless to red/fuchsia.

Q9. At what pH bromothymol blue changes colour from yellow to blue?
Ans: Bromothymol blue is a pH indicator. This indicator is yellow when pH is below 6.0. It is blue when the pH of the solution is above 7.6.

Q10. List the Examples of basic salts?
Ans: Following are the examples of basic salts.
Na_2CO_3, $NaHCO_3$, $Ca(HCO_3)_2$, $CaCO_3$, $Cu(OH)NO_3$, $Pb(OH)NO_3$, $NaOOCCH_3$, $MgCO_3$

Q11. List the examples of normal salts?
Ans: Examples of normal salts: **NaCl, KCl, KNO_3, $MgCl_2$, NH_4Cl, Na_2SO_4, K_2SO_4, $NaNO_3$, $CaCl_2$**

Q12. Which is a salt HCl or NaCl? **Ans: NaCl**

Q13. Which acid forms $NaNO_3$? **Ans: HNO_3**

Q14. Which acid forms $CaSO_4$? **Ans: H_2SO_4**

Q15. Write the names of some common acids and their salts.
Ans: Some common acids and their salts:

Acid	Salt name	Example
Hydrochloric HCl	Chloride Cl^-	NaCl, KCl, $CaCl_2$
Nitric HNO_3	Nitrate NO_3^{-1}	$NaNO_3$, KNO_3, $Ca(NO_3)_2$
Sulphuric H_2SO_4	Sulphate SO_4^{-2}	Na_2SO_4, K_2SO_4, $CaSO_4$
.Phosphoric H_3PO_4	Phosphate PO_4^{-3}	Na_3PO_4, K_3PO_4, $Ca_3(PO_4)_2$

Self-Assessment Exercise 10.1

◆ **Identify Bronsted acids and Bronsted bases in the following reactions.**

1. $H_2SO_4 + H_2O \rightleftharpoons HSO_4^- + H_3O^+$
2. $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$
3. $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

Because H_2O accepts the proton that H_2SO_4 donates and forms H_3O^+, water is a base.

2. $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$
Because CH_3COOH is converted to CH_3COO^- by donating proton, CH_3COOH is an acid.
Because H_2O accepts the proton that CH_3COOH donates and forms H_3O^+, water is a base.

3. $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$
H_2S is donating a proton, so H_2S is an acid. Because NH_3 accepts the proton and forms NH_4^+ so it is a base.

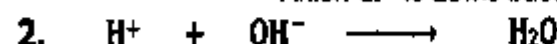
Self-Assessment Exercise 10.2

◆ **Identify the Lewis acid and the Lewis base in the following examples.**

1. $Cl^- + AlCl_3 \longrightarrow [AlCl_4]^-$ 2. $H^+ + OH^- \longrightarrow H_2O$

Solution: 1. $Cl^- + AlCl_3 \longrightarrow [AlCl_4]^-$

$AlCl_3$ is Lewis acid since it is able to accept electrons.
Anion Cl^- is Lewis base since it is able to donate electrons.

2. $H^+ + OH^- \longrightarrow H_2O$

Cation H^+ is Lewis acid since it is able to accept electrons.
Anion OH^- is Lewis base since it is able to donate electrons.

Self-Assessment Exercise 10.4

1. **Write names of three acid-base indicators.**
2. **What is the colour of methyl red in solution of (i) pH =4 (ii) pH=9**
3. **Bromothymol blue added to a solution imparts blue colour. What is the pH of solution? pH = 5 or 9**

Solution:

1. **Write names of three acid-base indicators.**

Solution: Bromothymol blue, methyl orange, phenolphthalein, methyl red, thymol blue.

Indicator	pH at which colour changes	Colour in acidic solution	Colour in basic solution
Methyl red	5.5	Red	Yellow
Bromothymol blue	7	Yellow	Blue
Phenolphthalein	9	Colourless	Pink

2. **What is the colour of methyl red in solution of (i) pH =4 (ii) pH=9**

Solution: (i) Red (ii) Yellow

3. **Bromothymol blue added to a solution imparts blue colour. What is the pH of solution? pH = 5 or 9**

Solution: **pH = 9**

Self-Assessment Exercise 10.5

1. **Hydroxides such as $Mg(OH)_2$ called milk of magnesia is used as antacid. It neutralizes excess stomach acid (HCl). Write complete and balanced chemical equation for this neutralization reaction?**
2. **Hydrochloric acid (HCl) and Potassium hydroxide (KOH) react and produce potassium chloride. Write complete and balanced chemical equation for this neutralization reaction?**
3. **Balance following neutralization reactions**

(ii) $H_3PO_{4(aq)} + NaOH_{(aq)} \longrightarrow Na_3PO_{4\,(aq)} + H_2O_{(l)}$

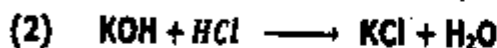
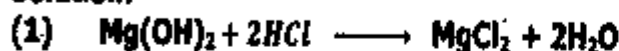
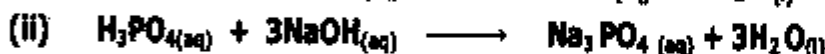
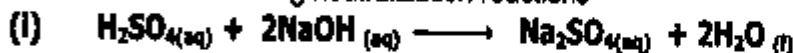
Solution:

(1) $Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$

(2) $KOH + HCl \longrightarrow KCl + H_2O$

3. Balance following neutralization reactions

(i) $H_2SO_{4(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$

(ii) $H_3PO_{4(aq)} + 3NaOH_{(aq)} \longrightarrow Na_3PO_{4\,(aq)} + 3H_2O_{(l)}$

Self-Assessment Exercise 10.6

- **Classify following salts as normal or acid salt.**

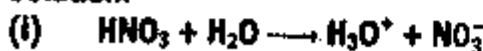
(a) $NaHSO_4$ (b) Na_2SO_4 (c) $KHCO_3$ (d) K_2CO_3

Solution: (a) $NaHSO_4$ is an acidic salt. (b) Na_2SO_4 is a normal salt.
(c) $KHCO_3$ is an acidic salt. (d) K_2CO_3 is a normal salt.

Q16. Identify Bronsted-Lowry acids or bases in the following reactions.

(i) $HNO_3 + H_2O \longrightarrow H_3O^+ + NO_3^-$ (ii) $NH_3 + HNO_3 \longrightarrow NH_4NO_3$

Solution:

(i) $HNO_3 + H_2O \longrightarrow H_3O^+ + NO_3^-$

Since HNO_3 is converted to NO_3^- by donating proton therefore HNO_3 is an acid.
Since H_2O accepts the proton that HNO_3 donates and forms H_3O^+, water is a base.

(ii) $NH_3 + HNO_3 \longrightarrow NH_4NO_3$

Since HNO_3 is converted to NO_3^- by donating proton therefore HNO_3 is an acid.
Since NH_3 accepts the proton and forms NH_4^+ so it is a base.

Q17. Classify the following solutions as acidic, basic or neutral.

(i) **A solution that has hydrogen ion concentration 1.0×10^{-3} M.**
(ii) **A solution that has hydrogen ion concentration 1.0×10^{-10} M.**
(iii) **A solution that has hydroxyl ion concentration 1.0×10^{-3} M.**
(iv) **A solution that has hydroxyl ion concentration 1.0×10^{-10} M.**

Solution:

(i) **A solution that has hydrogen ion concentration 1.0×10^{-3} M.**

$[H^+] = 1.0 \times 10^{-3}$ M $> 1.0 \times 10^{-7}$ M, the solution is acidic.

(ii) **A solution that has hydrogen ion concentration 1.0×10^{-10} M.**

$[H^+] = 1.0 \times 10^{-10}$ M $< 1.0 \times 10^{-7}$ M, the solution is basic.

(iii) **A solution that has hydroxyl ion concentration 1.0×10^{-3} M.**

$[OH^-] = 1.0\times10^{-3}$ M

$[H^+] = ?$

$k_w = [H^+][OH^-]$.

$1.0 \times 10^{-14} = [H^+][1.0 \times 10^{-3}]$

$$[H^+] = \frac{1.0\times10^{-14}}{1.0\times10^{-3}}$$

$[H^+] = 1.0\times 10^{-11}$ M

Because 1.0×10^{-11} M $< 1.0 \times 10^{-7}$ M, the solution is basic.

(iv) **A solution that has hydroxyl ion concentration 1.0×10^{-10} M.**

$[OH^-] = 1.0\times10^{-10}$ M

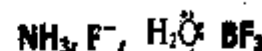
$[H^+] = ?$

$k_w = [H^+][OH^-]$.

$1.0 \times 10^{-14} = [H^+][1.0 \times 10^{-10}]$

$[H^+] = 1.0\times 10^{-4} M$

Because 1.0×10^{-4} M > 1.0×10^{-7} M, the solution is acidic.

Q18. Classify following substance as Lewis acid and bases. NH_3, F^-, $H_2\ddot{O}$ BF_3

Solution:

(i) Since NH_3 accepts the proton and forms NH_4^+ so it is a base.

(ii) F^- has a lone pair on F-atom. So it is electron pair donor. F^- is a Lewis base.

(iii) Since $H_2\ddot{O}$ donate a proton therefore $H_2\ddot{O}$ is an acid.

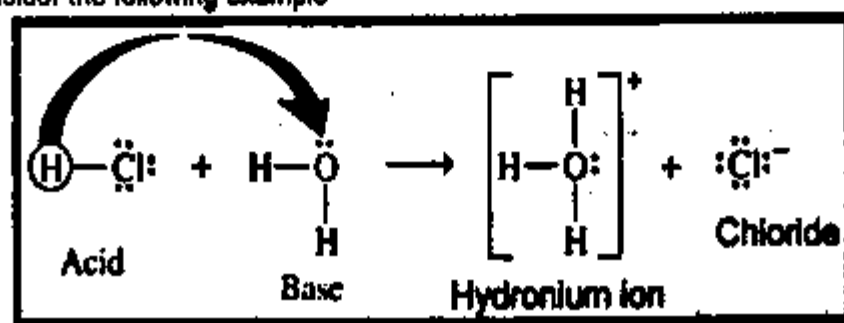
(iv) Boron in BF_3 has incomplete octet. It has six electrons (3 electron pairs).
So it needs an electron pair to complete its octet. Hence BF_3 is an electron pair accepter or Lewis acid.

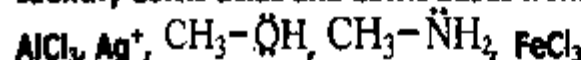
Q19. Give the Bronsted-Lowry definition of an acid.
Write an equation that illustrates the definition.

Ans: The Bronsted-Lowry concept of acids and bases:

In 1923 J.N Bronsted and T.M Lowery independently proposed another theory to overcome the shortcomings of Arrhenius theory. This theory is known as Bronsted-Lowery theory.

Acid: According to Bronsted-Lowry theory an acid is a proton donor.

Example: Consider the following example

Q20. Identify Lewis acids and Lewis bases from the following.

$AlCl_3$, Ag^+, $CH_3-\ddot{O}H$, $CH_3-\ddot{N}H_2$, $FeCl_3$

Solution:

$AlCl_3$: $AlCl_3$ is Lewis acid since it is able to accept electrons.

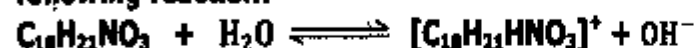
Ag^+: Ag^+ is Lewis acid since it is able to accept electrons.

$CH_3-\ddot{O}H$: $CH_3-\ddot{O}H$ is Lewis base since it is able to donate electrons.

$CH_3-\ddot{N}H_2$: $CH_3-\ddot{N}H_2$ is Lewis base since it is able to donate electrons.

$FeCl_3$: $FeCl_3$ is Lewis acid since it is able to accept electrons.

Q21. Codeine, $C_{18}H_{21}NO_3$ is a commonly prescribed pain killer. It dissolves in water by the following reaction?

$$C_{18}H_{21}NO_3 + H_2O \rightleftharpoons [C_{18}H_{21}HNO_3]^+ + OH^-$$

Differentiate Codeine and water as Bronsted –Lowry acid or base?

Solution: $C_{18}H_{21}NO_3 + H_2O \rightleftharpoons [C_{18}H_{21}HNO_3]^+ + OH^-$

Codeine, $C_{18}H_{21}NO_3$ is an acid because it is a proton donor.

Water H_2O is a base because it accepts a proton.

Q22. Bacteria in our mouth feed on small particles of food stuck to our teeth and change it into acid. Explain how using toothpaste of pH 10 can help to prevent the acid from damaging our teeth? Defend the statement.

Solution: Toothpaste of pH 10 mildly alkaline. The alkaline pH of toothpaste helps neutralize the plaque acids which cause tooth decay.

Q23. Can a substance be a Lewis acid without being a Bronsted-Lowry acid? Argue.

Ans: Yes, Bronsted Lowery acids are only addressing the release of H^+ molecules. A lewis acid describes a process where electrons are accepted from a donor compound. Since Bronsted only talks about hydrogen ions

GUESS PAPER & MODEL PAPER # 03
BASED ON CHAPTER # 11 (Reduced Syllabus)
ORGANIC CHEMISTRY

CHAPTER 11: ORGANIC CHEMISTRY

Topics: Organic compound, Chemical diversity and magnitude of organic compound, general characteristic of organic compound, condensed and structural formula, saturated and unsaturated hydrocarbon, Naming alkane, sources, and uses of organic compound, alkane and alkyl radical, classification of organic compound, functional group (complete topic).

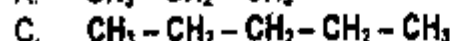
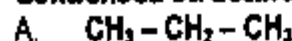
Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

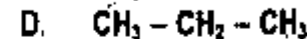
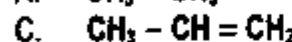
SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

i. Condensed structural formula for butane is
A. $CH_3-CH_2-CH_3$ B. $CH_3CH_2CH_2CH_3$
C. $CH_3-CH_2-CH_2-CH_2-CH_3$ D. CH_3-CH_3

ii. $CH_3-CH_2-CH_3$ is the chemical formula for
A. Ethane B. Propane C. Butane D. Pentane

iii. Which compound is not a saturated hydrocarbon?
A. CH_3-CH_3 B. CH_4
C. $CH_3-CH=CH_2$ D. $CH_3-CH_2-CH_3$

iv. Stem "But" stands for how many Carbon atoms.
A. 2 B. 3 C. 4 D. 5

v. Pitch is produced by
A. Coal B. Coal tar C. Coal gas D. Petroleum

vi. The functional group $-\overset{O}{\overset{\|}{C}}-$ is found in
A. alcohols B. Ketones C. Carboxylic acids D. esters

vii. In which of the following Compounds, oxygen is attached to two alkyl carbon atoms?
A. alcohol B. phenol C. ether D. ester

viii. Which of the following is an alcohol?
A. $CH_3-CH_2-O-CH_2-CH_3$ B. CH_3-CH_2-COOH
C. C_6H_5-OH D. CH_3-CH_2-OH

ix. The functional group of amines is

xi. Self-linking ability of carbon is called ________.
A. isomerism B. Catenation C. homologous D. homology

xii. A series of related compounds in which any two adjacent molecules differ by-CH_2-group is called ________ series.
A. homologous B. homology C. isomerism D. functional group

CHEMISTRY SSC-II

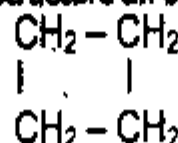
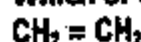
Time allowed: 2:40 hours Total Marks: 60

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet-B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

(i) What is catenation?
(ii) Define isomerism.
(iii) Give three examples of alkyl groups.
(iv) Define a functional group.
(v) Is the compound having following structure an open chain compound?

$$\begin{array}{ccc} CH_2 & - & CH_2 \\ | & & | \\ CH_2 & - & CH_2 \end{array}$$

(vi) What do you mean by the term structural formula?
(vii) List some general properties of organic compounds.
(viii) Which of the following compound is alkene, which is alkyne?

$CH_2 = CH_2$ (i) $HC \equiv CH$ (ii) $CH_3 - CH \equiv CH_2$ (iii)

SECTION – C (Marks 15)

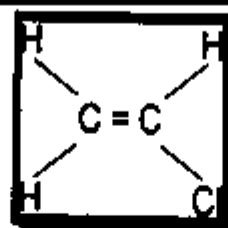
Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

(i) What is the name of the alkyl group obtained by removing an end hydrogen atom from
(i) propane (ii) ethane?
(ii) Give the structural formula of two simple alkanes and one alkyne.
(iii) Identify the type of following compounds as an alcohol, aldehyde or ketone:
(a) HCHO, which is used to manufacture polymers, such as urotropine which is used to treat urinary tract infection.
(b) CH_3COCH_3, which is used in nail polish remover.
(c) CH_3CH_2OH, which is used in the preparation of many organic substances such as plastics, cosmetics, tinctures etc.
(iv) Differentiate between alkane and alkyl radicals?
(v) What is the difference between methane and methyl radical? Which one contains a free valency?
(vi) List functional groups containing carbon, hydrogen and nitrogen?
(vii) List functional groups containing double and triple bond?

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q4. a. Recognize and identify the uses of organic compounds?
b. Briefly explain rules for naming alkanes according to IUPAC name?

Q5. a. Polyvinyl chloride (PVC) is a polymer. It is used for making vinyl sheets, drainage

Classify Vinyl chloride as saturated or unsaturated compound.

b. Classify organic compounds into straight chain, branched chain and cyclic compounds.

Q6. a. Identify the following compounds on the basis of functional groups they contain and encircle the functional group.

i. $CH_3 - CH = CH_3$

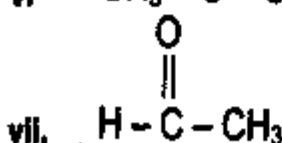
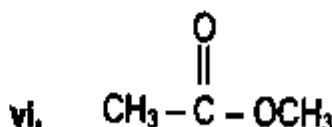
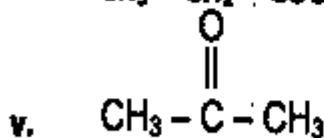
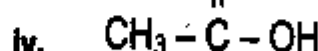
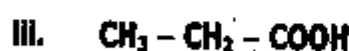
ii. $CH_3 - C \equiv CH$

iii. $CH_3 - CH_2 - COOH$

iv. $CH_3 - \overset{O}{\overset{||}{C}} - OH$

v. $CH_3 - \overset{O}{\overset{||}{C}} - CH_3$

vi. $CH_3 - \overset{O}{\overset{||}{C}} - OCH_3$

vii. $H - \overset{O}{\overset{||}{C}} - CH_3$

b. General formula for alkane is C_nH_{2n+2}. What will be the general formula for alkyl radical?

c. Water adds to ethene according to the following reaction

$$CH_2 = CH_2 + H_2O \longrightarrow CH_3CH_2OH$$

Identify functional groups in the reactant and product molecules.

SOLUTION OF GUESS PAPER & MODEL PAPER # 3
(Reduced Syllabus)

SECTION- A (MCQs)

i. B	ii. B	iii. C	iv. C	v. D	vi. B
vii. C	viii. D	ix. C	x. C	xi. B	xii. A

SECTION – B (Marks 18)

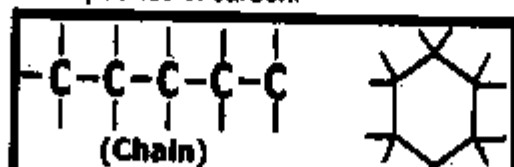
Q.2 Attempt any SIX parts from the following. All parts carry equal marks. **(6 × 3 = 18)**

(i) What is catenation?

Ans: Catenation: The self-linking ability of carbon atoms is called catenation.

OR

Catenation:

Catenation is the unique ability of carbon to bond itself forming long chains and rings and also to form compounds containing chains and rings together. This property of carbon results in enormous range of compounds of carbon.

(ii) Define isomerism.

Ans: Isomerism:

Compound having same molecular formula but different structural formula is called isomers and this phenomenon the process is called isomerism.

Isomers of the alkanes up to pentane:

Molecular formula	Structural formula	Number of isomers
Methane, CH_4	CH_4	1
Ethane, C_2H_6	CH_3-CH_3	1
Propane, C_3H_8	$CH_3-CH_2-CH_3$	1
Butane, C_4H_{10}	i) $CH_3-CH_2-CH_2-CH_3$ ii) $CH_3-CH(CH_3)-CH_3$	2

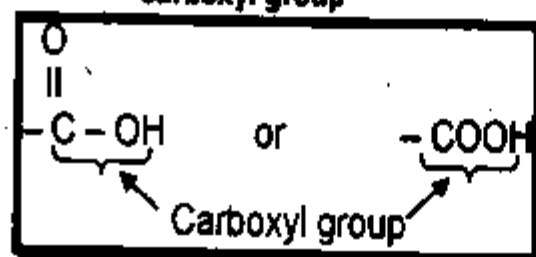
(iii) Give three examples of alkyl groups.

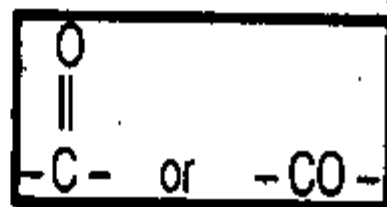
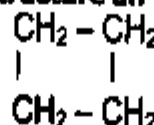
Ans: (i) **Methyl** CH_3- (ii) **Ethyl** CH_3CH_2- (iii) **Propyl** $CH_3-CH_2-CH_2-$

(iv) Define a functional group.

Ans: Functional Groups:

An atom or groups of atoms that give a family of organic compounds its characteristic chemical and physical properties is called a functional group.

Examples: **Carboxyl group** **Carbonyl group**

(v) Is the compound having following structure an open chain compound?

$$\begin{array}{c} CH_2-CH_2 \\ | \quad\quad | \\ CH_2-CH_2 \end{array}$$

Ans: Compound is closed chain or cyclic compound. The name of compound is cyclo butane.

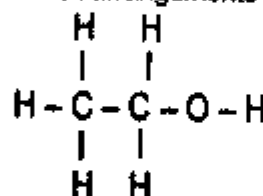
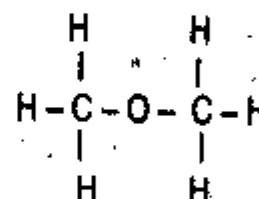
(vi) What do you mean by the term structural formula?

Ans: Structural Formulas:

A formula that describes the arrangement of atoms in molecules is called as structural formula.

Examples: For example, two organic compounds have the molecular formula C_2H_6O. They have different arrangements of atoms.

Ethanol

$$\begin{array}{c} H \quad\quad\quad H \\ | \quad\quad\quad | \\ H-C-O-C-H \\ | \quad\quad\quad | \\ H \quad\quad\quad H \end{array}$$

Dimethy ether

(vii) List some general properties of organic compounds.

Ans: General Characteristics of Organic Compounds:

(i) **Occurrence:** Most of them come from living things or from the things that were once living.

(ii) **Covalent nature:**

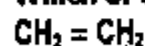
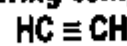
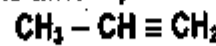
Other elements like oxygen, nitrogen, sulphur, phosphorous and halogens are present in many organic compounds.

(iv) Melting and boiling point:
Generally organic compounds are volatile. So they have low melting and boiling points.

(v) Solubility:
Organic compounds are non-polar in nature; therefore mostly they are soluble in organic solvents such as ether, benzene, carbon disulphide etc. Polar Organic Compounds are soluble in alcohols such as methyl alcohol and ethyl alcohol.

(vi) Similarity in behaviours (Homology):
There exists a close relationship between different organic compounds. This similarity in behavior has made the study of millions of organic compounds easier. They can be classified into few families. A series of related compounds in which any two adjacent molecules differ by $-CH_2-$ group is called homologous series.

(vii) Reaction rates:
Organic compounds are generally less stable than inorganic compounds. Due to covalent bonding in them, their reaction rates are often slow.

(viii) Which of the following compound is alkene, which is alkyne?

$CH_2 = CH_2$ (i) $HC \equiv CH$ (ii) $CH_3 - CH \equiv CH_2$ (iii)

Ans: **(i)** is alkene where as **(ii)** and **(iii)** are alkynes.

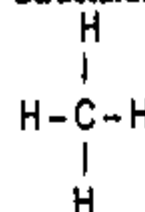
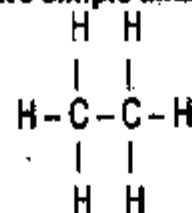
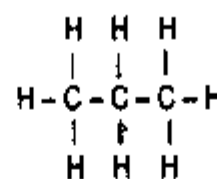
SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

(i) What is the name of the alkyl group obtained by removing an end hydrogen atom from
(i) propane (ii) ethane?

Ans: (i) Propyl (ii) Ethyl

(ii) Give the structural formula of two simple alkanes and one alkyne.

Ans: Structural formula of two simple alkanes:

Structural formula of one alkyne: **$CH_3 - C \equiv CH$ (Propyne)**
$CH \equiv CH$ (Ethyne)

(iii) Identify the type of following compounds as an alcohol, aldehyde or ketone:
(a) HCHO, which is used to manufacture polymers, such as urotropine which is used to treat urinary tract infection.
(b) CH_3COCH_3, which is used in nail polish remover.
(c) CH_3CH_2OH, which is used in the preparation of many organic substances such as plastics, cosmetics, tinctures etc.

Solution:
(a) **HCHO:** Aldehyde because CHO– group is attached.
(b) **CH_3COCH_3:** Ketone because CO– group is attached.
(c) **CH_3CH_2OH:** Alcohol because OH group is attached to an alkyl group.

(iv) Differentiate between alkane and alkyl radicals?

Ans: Alkane and Alkyl radicals:
Recall that an alkane is a hydrocarbon containing only single bonds and have general formula C_nH_{2n+2}.

(v) What is the difference between methane and methyl radical? Which one contains a free valency?

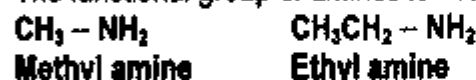
Ans: Methyl radical is obtained by removing one hydrogen atom from methane.

CH_4 — **Methane** CH_3- — **Methyl** Methyl radical contain a free valency

(vi) List functional groups containing carbon, hydrogen and nitrogen?

Ans: Functional groups containing Carbon, Hydrogen and Nitrogen:

Amines: The functional group of amines is $-NH_2$

CH_3-NH_2 — **Methyl amine** $CH_3CH_2-NH_2$ — **Ethyl amine**

General formula for amines: The general formula for amines is $R-NH_2$

(vii) List functional groups containing double and triple bond?

Ans: Functional groups containing Double and Triple bond:

Alkene: An alkene is a hydrocarbon that contains one or more carbon-carbon double bond. C=C is the functional group for alkenes. $CH_2=CH_2$

Alkyne: An alkyne is a hydrocarbon that contains one or more carbon-carbon triple bond. C≡C is the functional group for alkynes. Which of the following compound is alkene, which is alkyne?

$HC\equiv CH$ $CH_3-CH\equiv CH_2$

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. **(2 × 10 = 20)**

Q4. a. Recognize and identify the uses of organic compounds?

Ans: Uses of Organic Compounds.

i. Natural gas and petroleum are used primarily as fuels. These are also used as starting materials for the productions of variety of organic compounds.

ii. Propane and butane which are gases obtained from natural gas are widely available as liquids in fuel cylinders (**LPG**).

iii. Ethylene is the major starting material for the manufacture of organic chemicals and products such as polyethylene (plastic), ethyl alcohol, acetic acid and ethylene glycol called antifreeze.

iv. Acetylene is widely used in the oxy-acetylene welding and cutting metals, Acetylene is also used in the preparation of polymers like PVC (polyvinyl chloride), polyvinyl acetate, synthetic rubber, nylon etc.

v. Acetylene is used for artificial ripening of fruits.

vi. Compounds of phenol help to ensure antiseptic conditions in hospital operating rooms.

vii. Methanol is used as a solvent for fats, oils, paints and varnishes.

viii. Many organic compounds are used in the manufacture of drugs, dyes, cosmetics, detergents and soaps, nylon, emulsions and paints etc.

b. Briefly explain rules for naming alkanes according to IUPAC name?

Ans: Naming Alkanes:

The key point in naming a straight chain alkane is that the name is based on the number of carbon atoms in the chain. The IUPAC (international union of pure and applied chemistry) name has three parts.

(i) Stem: The stem tells the number of carbon atoms in the chain.

Numerical stems for carbon chains:

Stem	Number of C - atoms
Meth-	1
Eth-	2
Prop-	3
But-	4
Pent-	5

Oct-	8
Non-	9
Dec-	10

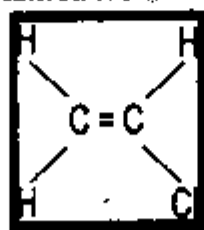
(ii) Suffix:

Suffix is placed after the stem, it tells the class of compound. For alkane, the suffix "ane" is used.

Suffix it indicates alkane

Butane

Stem, it indicate no of carbon atoms stem

Q5. a. Polyvinyl chloride (PVC) is a polymer, it is used for making vinyl sheets, drainage pipes, wire insulation etc. It is obtained from vinyl chloride.

Classify Vinyl chloride as saturated or unsaturated compound.

Solution: Vinyl chloride is a unsaturated compound because it contain carbon-carbon double bond.

b. Classify organic compounds into straight chain, branched chain and cyclic compounds.

Ans: Classification of Organic Compounds:

Organic Compounds are broadly classified into two main groups.

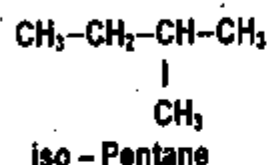
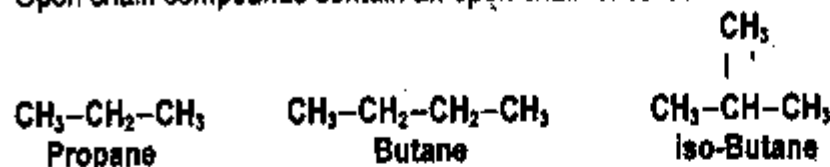
(i) Open chain compounds or Alicyclic compounds.

(ii) Closed chain or Cyclic Compounds.

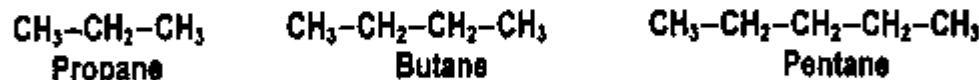
(i) Open chain compounds or Alicyclic compounds:

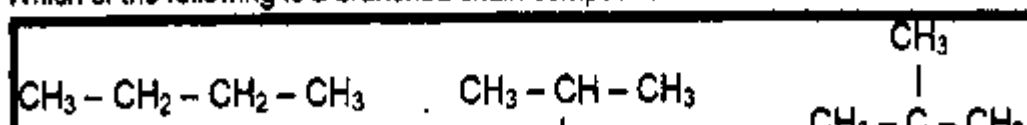
Open chain compounds contain an open chain of carbon atoms. For instance;

$CH_3-CH_2-CH_3$ **Propane** $CH_3-CH_2-CH_2-CH_3$ **Butane** $CH_3-CH(CH_3)-CH_3$ **iso-Butane**

$CH_3-CH_2-CH(CH_3)-CH_3$ **iso – Pentane**

Types of open chain compounds:

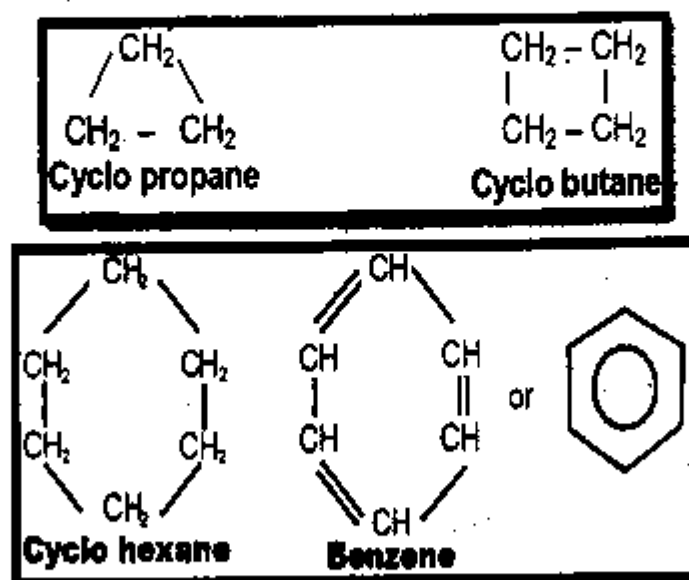
Open chain compounds maybe either straight-chain or branched-chain. Those compounds which contain any number of carbon atoms joined one after the other in a chain or row are called **straight - chain compounds.**

For example $CH_3-CH_2-CH_3$ **Propane** $CH_3-CH_2-CH_2-CH_3$ **Butane** $CH_3-CH_2-CH_2-CH_2-CH_3$ **Pentane**

Those compounds which contain carbon atoms on the sides of chain are called branched chain compounds. Which of the following is a branched chain compound?

$CH_3-CH_2-CH_2-CH_3$ $CH_3-CH-CH_3$ CH_3 | CH_3-C-CH_3

Open chain compound are also called alicyclic compounds.

(II) Closed Chain or Cyclic Compounds:

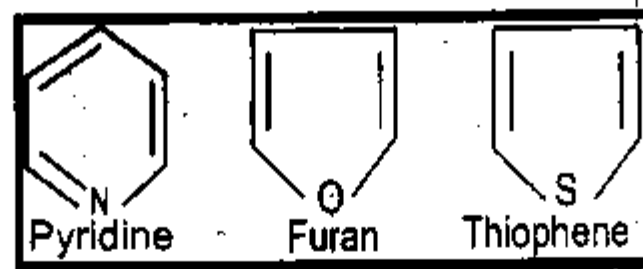
Organic compounds which contain rings of atoms are called closed chain or cyclic compounds.

For example

Types of cyclic compounds:

Homocyclic or carbocyclic compounds:

Cyclic compounds which contain rings of carbon atoms are called homocyclic or carbocyclic compounds.

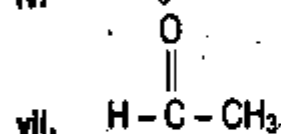
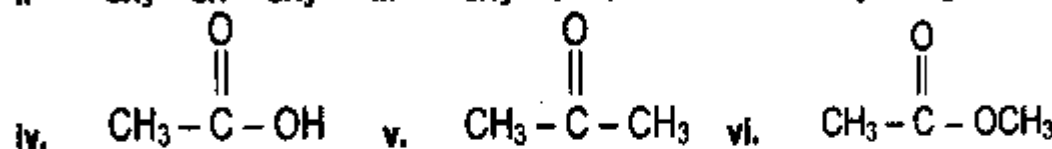
Heterocyclic compounds:

Cyclic compounds that contain one or more atoms other than carbon atoms in the ring are called heterocyclic compounds e.g.

Q6. a. Identify the following compounds on the basis of functional groups they contain and encircle the functional group.

i. $CH_3 - CH = CH_3$ ii. $CH_3 - C \equiv CH$ iii. $CH_3 - CH_2 - COOH$

iv. $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - OH$ v. $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_3$ vi. $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - OCH_3$

vii. $H - \overset{\overset{\displaystyle O}{\|}}{C} - CH_3$

Ans:

i.	$CH_3 - CH = CH_3$ Alkene	**ii.**	$CH_3 - C \equiv CH$ Alkyne
iii.	$CH_3 - CH_2 - COOH$ Carboxyl group	**iv.**	O ‖

v.	vi.
$CH_3-\overset{O}{\overset{\parallel}{C}}-CH_3$ Carbonyl group	$CH_3-\overset{O}{\overset{\parallel}{C}}-OCH_3$ Easter group
vii.	
$H-\overset{O}{\overset{\parallel}{C}}-CH_3$ Carbonyl group	

b. General formula for alkane is C_nH_{2n+2}. What will be the general formula for alkyl radical?

Solution: **General formula for alkyl radical:** C_nH_{2n+1}

c. Water adds to ethene according to the following reaction

$$CH_2 = CH_2 + H_2O \longrightarrow CH_3CH_2OH$$

Identify functional groups in the reactant and product molecules.

Solution: **Functional groups in the reactant:** Alkene
Functional groups in the product: Alcohol

Important Questions & Answers (Reduced Syllabus)

Q1. Define organic compounds?

Ans: Organic Compounds: Organic compounds are defined as the hydrocarbons and their derivatives.

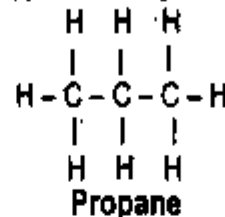
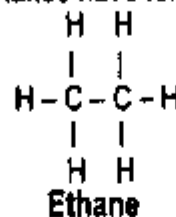
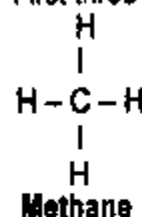
Q2. What is the number of isomers in pentane? **Ans:** Pentane has three isomers.

Q3. What is the number of isomers in hexane? **Ans:** Hexane has five isomers.

Q4. Write structural formulas, the condensed structural formulas and molecular formulas of first three members of alkanes?

Ans: The simple alkanes are straight-chain hydrocarbons.

First three members of alkanes have following **structural formulas.**

```
     H              H  H              H  H  H
     |              |  |              |  |  |
   H-C-H          H-C--C-H          H-C--C--C-H
     |              |  |              |  |  |
     H              H  H              H  H  H
  Methane          Ethane            Propane
```

Condensed structural formulas: The condensed structural formulas of first three alkanes are

CH_4 CH_3CH_3 $CH_3CH_2CH_3$

Molecular formulas: The corresponding molecular formulas are CH_4, C_2H_6, C_3H_8

Q5. Briefly explain the term condensed formula?

Ans: Condensed formula:

A condensed formula is a structural formula that uses established abbreviation for various groups of chain. In condensed structural formula, we list the main chain carbon atoms and the hydrogen atoms attached to them in the sequence in which they appear in the naming system.

For instance:

H | H – C – shown as CH (Methyl)	H | C – as CH (Methylene)

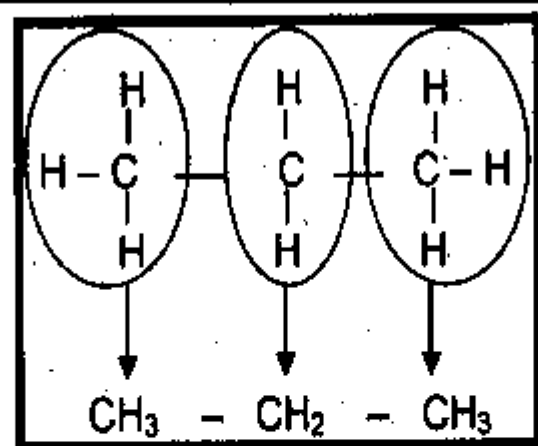



Table shows the condensed structural formulas of some alkanes.

Condensed structural formula of some alkanes:

Name	Molecular Formula	Condensed Formula
Butane	C_4H_{10}	$CH_3-CH_2-CH_2-CH_3$
Pentane	C_5H_{12}	$CH_3CH_2CH_2CH_2CH_3$
Hexane	C_6H_{14}	$CH_3CH_2CH_2CH_2CH_2CH_3$
Heptane	C_7H_{16}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_3$
Octane	C_8H_{18}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
Nonane	C_9H_{20}	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
Decane	$C_{10}H_{22}$	$CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

Self-Assessment Exercise 11.1

◆ **Give the molecular, structural and condensed structural formulas for**

(a) Butane (b) Hexane (c) Octane

Solution: (a) Butane

Molecular formula: C_4H_{10} **Structural formula:** $CH_3-CH_2-CH_2-CH_3$

n – Butane

Condensed Structural formula: $CH_3CH_2CH_2CH_3$

(b) Hexane

Molecular formula: C_6H_{14} **Structural formula:** $CH_3-CH_2-CH_2-CH_2-CH_2-CH_3$

n - Hexane

Condensed Structural formula: $CH_3CH_2CH_2CH_2CH_2CH_3$

(c) Octane

Molecular formula: C_8H_{18}

Structural formula: $CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3$

n - octane

Condensed Structural formula: $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

Self-Assessment Exercise 11.2

Solution:

(i) $CH_3 - CH_2 - CH_3$ Saturated Hydrocarbon (single covalent bond)
(ii) $CH_3 - C \equiv CH$ Unsaturated Hydrocarbon (triple covalent bond)
(iii) $CH_3 - CH = CH_2$ Unsaturated Hydrocarbon (double covalent bond)
(iv) $CH_2 = CH - CH = CH_2$ Unsaturated Hydrocarbon (double covalent bond)

Self-Assessment Exercise 11.3

◆ **Write IUPAC names of the following alkanes.**

(i) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
(ii) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
(iii) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
(iv) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
(v) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$

Solution:

(i) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
Number of carbon atoms = 6 , Name = hexane
(ii) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
Number of carbon atoms = 8 , Name = octane
(iii) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
Number of carbon atoms = 7 , Name = heptane
(iv) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
Number of carbon atoms = 10 , Name = decane
(v) $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$
Number of carbon atoms = 9 , Name = nonane

Self-Assessment Exercise 11.4

1. **List the names of major sources of alkanes.**
2. **What is natural gas?**
3. **Write some uses of acetylene.**

Solution:

1. **Major sources of alkanes:**
The major commercial sources of alkanes are coal, natural gas, petroleum, and living organisms.
2. **Natural gas:**
Natural gas is a mixture of low boiling hydrocarbons. Natural gas is mostly methane. It also contains smaller amounts of ethane, propane and butane.
3. **Uses of acetylene:**
Acetylene is widely used in the oxy-acetylene welding and cutting metals, Acetylene is also used in the preparation of polymers like PVC (polyvinyl chloride), polyvinyl acetate, synthetic rubber, nylon etc. Acetylene is used for artificial ripening of fruits.

Self-Assessment Exercise 11.5

◆ **Derive alkyl radicals from the following alkanes.**

a. Ethane **b. Butane** **c. Propane**

Solution:

b. $CH_3CH_2CH_2CH_3$ — Butane; $CH_3CH_2CH_2CH_2-$ — Butyl

c. $CH_3CH_2CH_3$ — propane; $CH_3CH_2CH_2-$ — Propyl

Q6. List the functional groups containing carbon, hydrogen and halogens?

OR

What do you understand by haloalkanes?

Ans: Functional groups containing carbon, hydrogen and halogens: (Haloalkanes)

Haloalkanes are characterized by the presence of the halogen atom. The haloalkane is compound in which one hydrogen atom of an alkane is substituted by one halogen atom.

Examples of haloalkanes: CH_3-Cl **Chloromethane** CH_3-Br **Bromomethane**

Q7. Which of the following molecules are haloalkanes?

CH_4	CH_3-Cl	CH_3-Br	CH_3CH_3	CH_3CH_2-Cl
Methane	Chloromethane	Bromomethane	Ethane	Chloroethane

Ans: Chloromethane, Bromomethane and Chloroethane are haloalkanes.

Q8. List the functional groups containing carbon, hydrogen and oxygen?

Ans: i. Alcohols ii. Phenols iiii. Ethers iv. Aldehydes v. ketones vi. Carboxylic Acids vii. Esters

Q9. What do you understand by the functional group of alcohols?

Ans: Alcohols: Alcohols are characterized by the presence of the hydroxyl group. **(−OH)** attached to a hydrocarbon chain.

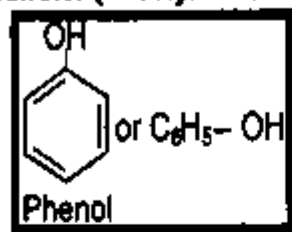
CH_3-OH **Methanol (Methyl alcohol)** CH_3-CH_2-OH **Ethanol (Ethyl alcohol)**

General formula for alcohols: **R−OH** is the general formula for alcohols.

Which of the following compounds is alcohol?

$CH_3CH_2CH_2OH$ **1-Propanonol** $CH_3CH_2CH_2CH_2OH$ **1-Butanol**

Q10. What do you understand by the functional group of phenols?

Ans: Phenols: (− OH): When an **− OH** group is attached to a benzene ring, the compound is called a phenol.

Phenol was the first antiseptic used in an operation theatre.

Q11. What do you understand by the functional group of ethers?

Ans: Ethers: (C−O−C)

Organic compounds that have two alkyl groups attached to the same oxygen atom are called ethers. These compounds have **C−O−C** linkage in their molecules.

CH_3-O-CH_3 **Dimethyl ether** $CH_3-O-CH_2-CH_3$ **Ethyl methyl ether** $CH_3-CH_2-O-CH_2-CH_3$ **Diethyl ether**

General formula for ethers: The general formula for ethers is **R-O-R'**.

Where R and R' are alkyl groups which may be same or different.

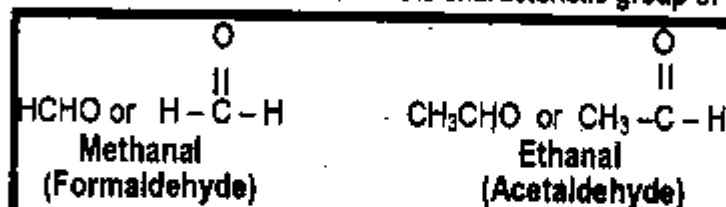
Q12. Briefly explain the functional group of aldehydes and ketones?

Ans: Aldehydes (−CHO) and ketones:

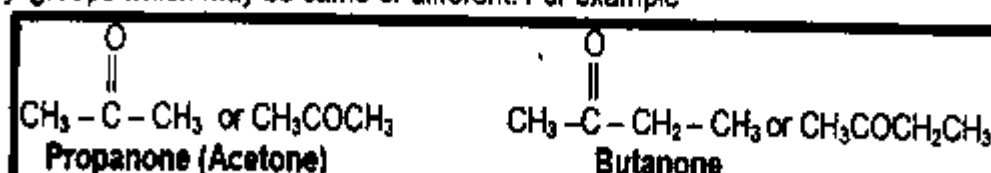
Aldehydes and ketones contain the carbonyl group

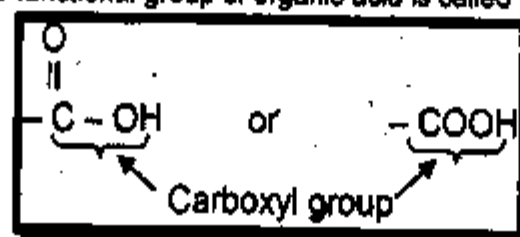
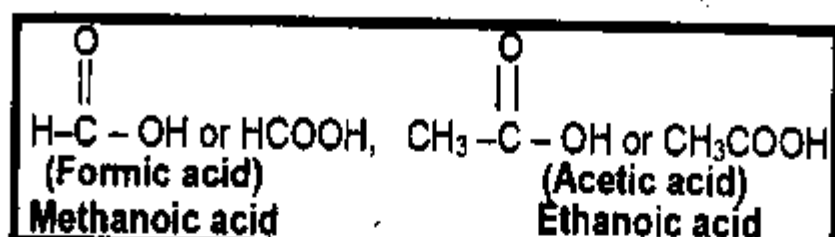
Carbonyl group

An aldehyde has at least one hydrogen atom or two hydrogen atoms attached to the carbonyl carbon atom.
A ketone has two hydrocarbon groups (alkyl) bonded to the carbonyl carbon atom.

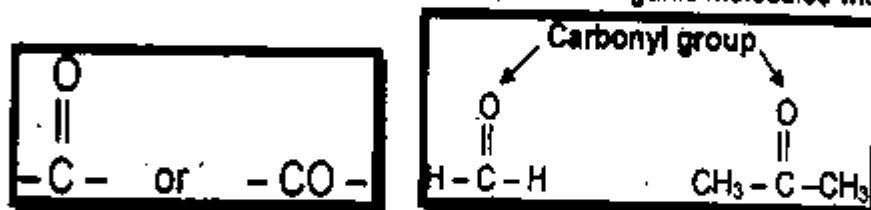
$-\overset{\overset{\displaystyle O}{||}}{C}-H$ group in condensed form is written as **–CHO**. It is characteristic group of aldehydes.

General formula for ketone:

The general formula for ketone is $R-\overset{\overset{\displaystyle O}{||}}{C}-R'$ and in condensed form it is written as **RCOR'**. Where R and R' are alkyl groups which may be same or different. For example

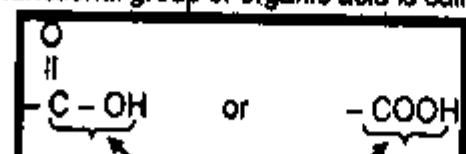
$CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_3$ or CH_3COCH_3 **Propanone (Acetone)** $CH_3-\overset{\overset{\displaystyle O}{||}}{C}-CH_2-CH_3$ or $CH_3COCH_2CH_3$ **Butanone**

Q13. What do you understand by the functional group of carboxylic acids?

Ans: Carboxylic Acids: The functional group of organic acid is called the carboxyl group.

Examples:

The general formula for carboxylic acids is **R - COOH or R - C - OH**.

Q14. What is the difference between a carbonyl group and a carboxyl groups?

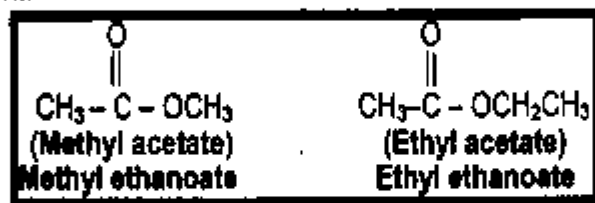
Ans: Carbonyl group: Carbonyl group is a functional group with double bonded oxygen to a carbon. Aldehydes and ketones are known as organic molecules with a carbonyl group.

Aldehydes and ketones contain the carbonyl group

Carboxylic Acids: The functional group of organic acid is called the carboxyl group.

$-\overset{\overset{\displaystyle O}{||}}{C}-OH$ or $-COOH$

Q15. What do you understand by the functional group of esters?

Ans: Esters:

Compounds having general formula $R-\overset{O}{\overset{\|}{C}}-R'$ are called esters. R and R are alkyl groups which maybe same or different.

$CH_3-\overset{O}{\overset{\|}{C}}-OCH_3$	$CH_3-\overset{O}{\overset{\|}{C}}-OCH_2CH_3$
(Methyl acetate)	**(Ethyl acetate)**
Methyl ethanoate	**Ethyl ethanoate**

$-\overset{O}{\overset{\|}{C}}-OR'$ is the functional group for esters.

Q16. Which of the following compound is alkene, which is alkyne?

i. $CH_2 = CH_2$ ii. $HC \equiv CH$ iii. $CH_3 - CH = CH_2$

Ans:
- i. **$CH_2 = CH_2$ (Ethene):** It is an alkene because it contain double bond (=)
- ii. **$HC \equiv CH$ (Ethyne):** It is an alkyne because it contain triple bond (≡)
- iii. **$CH_3 - CH = CH_2$ (Propene):** It is an alkene because it contain double bond (=)

Self-Assessment Exercise 11.7

◆ **Classify the following as alcohol, ether or phenol.**

(a) $CH_3CH_2OCH_2CH_3$ (b) $CH_3CH_2CH_2OH$ (c) C_6H_5OH (d) C_2H_5OH

Solution:
- (a) $CH_3CH_2OCH_2CH_3$ — **Ether because** O – atom is attached to two alkyl groups.
- (b) $CH_3CH_2CH_2OH$ — **Alcohol because** OH group is attached to an alkyl group.
- (c) C_6H_5OH — **Phenol because** – OH is attached to benzene ring.
- (d) C_2H_5OH — **Alcohol because** OH group is attached to an alkyl group.

Self-Assessment Exercise 11.8

◆ **Identify the following compounds as an aldehyde, or a ketone or a carboxylic acid.**

(a) $CH_3COCH_2CH_3$ (b) $CH_3CH_2CH_2\overset{O}{\overset{\|}{C}}H$ (c) $CH_3CH_2\overset{O}{\overset{\|}{C}}OH$

Solution:
- (a) Ketone because the carbonyl carbon is between two other carbon atoms.
- (b) Aldehyde because a hydrogen atom is attached to the carbonyl carbon atom.
- (c) Carboxylic acid because –OH group is attached to the carbonyl carbon atom.

Q17. List major commercial sources of alkanes.

Ans: Sources of Organic Compounds

The major commercial sources of alkanes are coal, natural gas, petroleum, and living organisms.

i. Coal:

Coal is a source of many organic compounds. When coal is heated in the absence of air at high temperature, it is converted into coal gas, coal tar and coke.

This process is called destructive distillation. Coal is also used as solid fuel.

Coal gas contains methane, hydrogen and carbon monoxide gases. It is mainly used as a fuel in industry. Coal tar is a source of many organic compounds such as benzene and its derivatives. These compounds can be separated by fractional distillation. These are very useful substances in synthetic organic

iii. Petroleum:

Petroleum contains a wide variety of alkanes including those having very long chains. On fractional distillation petroleum separates into various hydrocarbon components, known as fractions. Each fraction is not a pure compound but a mixture of different compounds that boil in a certain range of temperature.

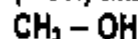
iv. Living Organisms:

Many important organic compounds such as proteins, fats, carbohydrates, vitamins, drugs and medicines are obtained from plants and animals.

Q18. What is the name of alkane having seven carbon atoms in the chain?

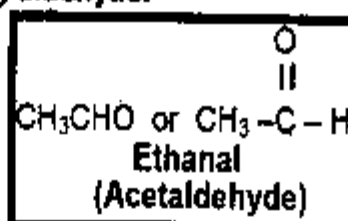
Ans: Heptane (C_7H_{16})

Q19. Give molecular formula of a compound containing C, H and O and single bonds. List all the possible functional groups this compound can have?

Solution: Alcohols are characterized by the presence of the hydroxyl group. (–OH) attached to a hydrocarbon chain.

CH_3-OH	CH_3-CH_2-OH
Methanol	**Ethanol**
(Methyl alcohol)	**(Ethyl alcohol)**

General formula for alcohols: **R–OH** is the general formula for alcohols.

$CH_3CH_2CH_2OH$	$CH_3CH_2CH_2CH_2OH$
1-Propanonol	**1-Butanol**

Q20. For each of the following, draw the structural formulas of a two-carbon compound containing the indicated functional group.

(a) alcohol **(b) aldehyde** **(c) carboxylic acid** **(d) alkene**

Solution:

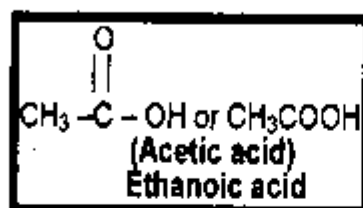
(a) alcohol:

CH_3-CH_2-OH
Ethanol (Ethyl alcohol)

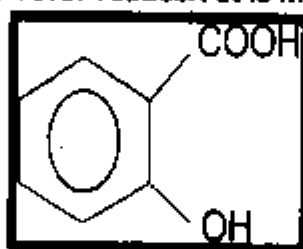
(b) aldehyde:

CH_3CHO or $CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-H$
Ethanal
(Acetaldehyde)

(c) carboxylic acid:

$CH_3-\overset{\overset{\displaystyle O}{\|}}{C}-OH$ or CH_3COOH
(Acetic acid)
Ethanoic acid

(d) alkene:

$CH_2=CH_2$ **(Ethene)**

Q21. Aspirin is a mild pain killer and fever reducer. It is manufactured from salicylic acid.

Select functional groups present in it and encircle them. Justify your selection.

Solution: Function Groups: i. Carboxyl group **ii.** Carbonyl group

Q22. Bonding of carbon atom to heteroatoms increases the number of organic compounds. Justify it.

Solution: All heteroatoms have a greater or lesser attraction for electrons than does carbon. Thus, each bond between a carbon and a heteroatom is polar. The most important atomic groupings that contain such reactive

GUESS PAPER & MODEL PAPER # 04
BASED ON CHAPTER # 12 (Reduced Syllabus)
HYDROCARBONS

CHAPTER 12 : HYDROCARBONS

Topics: Hydrocarbon and its types, Alkane, preparation of alkanes, Properties of alkanes, Alkene, preparation of alkene, Properties of alkenes, Alkynes, preparation of alkynes, Properties of alkynes.

Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

(i) Which molecule contains a carbon-carbon double bond?
A. Ethane B. Ethene C. Ethyne D. Ethyl alcohol

(ii) Which product is obtained when chloromethane (or methyl chloride) is reduced?
A. Ethane B. Ethene C. Methane D. Ethyne

(iii) Which reacts explosively with methane?
A. F_2 B. Cl_2 C. Br_2 D. I_2

(iv) By dehydration we mean, the removal of
A. Hydrogen B. Water C. Halogen D. Hydrogen halide

(v) Ethene and ethyne can be differentiated by
A. Hydrogenation B. Bromine water
C. Dilute alkaline aqueous solution of $KMnO_4$ D. Hydrohalogenation

(vi) Which is used for dehydrohalogenation?
A. Br_2 water B. Conc. H_2SO_4 C. Al_2O_3 D. Alcoholic KOH

(vii) Which substance reacts with $KMnO_4$ to produced oxalic acid?
A. Ethane B. Ethene C. Ethyne D. Ethyl alcohol

(viii) The reduction of alkyl halides takes place in the presence of
A. Al_2O_3 at 350° C B. Conc. H_2SO_4 at 170° C
C. Zn + Dust D. Zn + HCl

(ix) Which process produces an alkane?
A. Combustion B. Hydration C. Dehydration D. Hydrogenation

(x) Does not react with aqueous solution of bromine
A. C_2H_6 B. C_2H_4 C. C_2H_2 D. C_3H_6

(xi) The concentration of carbon dioxide in the atmosphere has increased up to by the end of twentieth century.
A. 40% B. 30% C. 10% D. 20%

(xii) 1% alkaline aqueous solution of $KMnO_4$ is used to detect the ...

CHEMISTRY SSC-II

Time allowed: 2:40 hours **Total Marks: 53**

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

(i) Give three examples of unsaturated hydrocarbons.
(ii) Draw electron dot and cross structure for ethene.
(iii) Draw structural formulas of an alkane, an alkene and an alkyne containing five carbon atoms.
(iv) How can you differentiate ethane from ethene?
(v) What do you mean by dehydration reaction? Give one example.
(vi) How can you convert
 (i) ethene into ethane (ii) methane into carbontetrachloride
 (iii) ethene into glycol (iv) ethyl chloride into ethane
 (v) ethyl bromide into ethene
(vii) Write a chemical equation to show the preparation of an alkane from an alkene and an alkyne.
(viii) Write a chemical equation to show the preparation of ethene from dehydration of an alcohol and dehydrohalogenation of alkyl halides.

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

(i) Write a chemical equation to show the preparation of ethyne from dehalogenation of 1, 2-dihalide and a tetrahalide.
(ii) Write chemical equations showing reaction of $KMnO_4$ with ethene and ethyne.
(iii) List some industrial uses of ethene and ethyne.
(iv) Describe the trends in reactivity of halogen with alkanes?
(v) Draw electron dot and cross structure for (a) Propane (b) Propyne (c) Propene
(vi) What do you understand by the combustion of methane?
(vii) List some properties of Alkanes?

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q4. a. Differentiate between ethene and athyne.
 b. How can you convert ethene into ethane?
Q5. a. Write chemical equations showing reactions of alkenes with halogens?
 b. List the properties of alkynes?
Q6. a. Write a chemical equation to show the preparation of an alkane from an alkene and an alkyne.
 b. What happens when Methane is treated with chlorine in the presence of diffused sun light?

SOLUTION OF GUESS PAPER & MODEL PAPER # 4
(Reduced Syllabus)

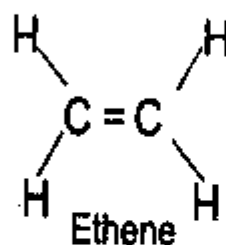
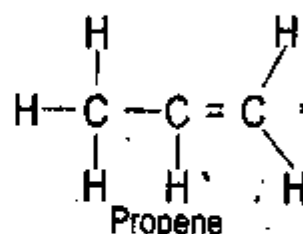
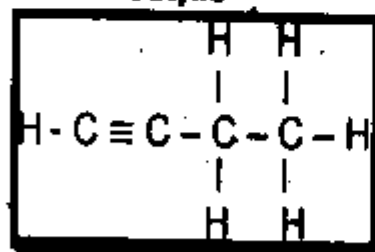
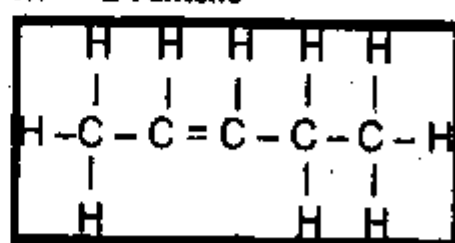
SECTION- A (MCQs)

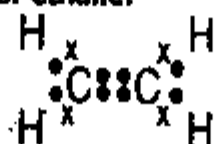
SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. **(6 × 3 = 18)**

(i) Give three examples of unsaturated hydrocarbons.

Ans: i.

ii.

iv. **2-Pentene**

(ii) Draw electron dot and cross structure for ethene.

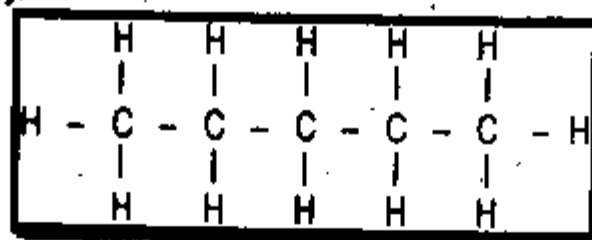
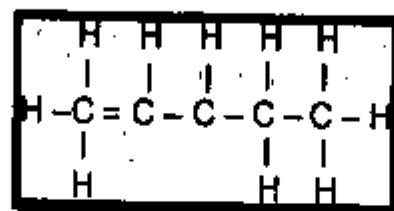
Ans: **Electron dot and cross structure for ethane:**

```
H x       x H
  •C ::C•
H x       x H
```

(iii) Draw structural formulas of an alkane, an alkene and an alkyne containing five carbon atoms.

Ans: **Alkane (Pentane):**

```
    H   H   H   H   H
    |   |   |   |   |
H - C - C - C - C - C - H
    |   |   |   |   |
    H   H   H   H   H
```

Alkene (1 – Pentene):

```
   H   H   H   H   H
   |   |   |   |   |
H -C = C - C - C - C - H
   |           |   |
   H           H   H
```

(iv) How can you differentiate ethane from ethene?

Ans: Add a small amount of bromine water to each jar. Shake the jar containing ethene will decolour the bromine water. The jar containing the ethane the bromine water will remain brown

This is because the Br_2 will add on across the double bond of the unsaturated ethene to produce dibromoethane. The Br_2 is removed from the water which becomes clear.

In the case of ethane this is already saturated , so no reaction occurs - Bromine water remains brown

```
H       H                H   H
 \     /                 |   |
  C = C   + Br – Br ——→ H – C – C – H
```

(v) What do you mean by dehydration reaction? Give one example.

Ans: Dehydration: Dehydration means loss of water.

Examples: Alcohols dehydrate when their vapour are passed over heated alumina.

Concentrated Sulphuric acid is also used for dehydration.

$$CH_3-CH_2(OH) \xrightarrow[140\text{-}170°C]{Conc.H_2SO_4} CH_2=CH_2 + H_2O$$

(vi) How can you convert

(i) ethene into ethane
(ii) methane into carbontetrachloride
(iii) ethene into glycol
(iv) ethyl chloride into ethane
(v) ethyl bromide into ethene

Solution: (i) Ethene into ethane

$$CH_2=CH_2 + H_2 \xrightarrow[200-300°C]{Ni} CH_2-CH_2$$

(ii) Methane into carbontetrachloride

$$CH_{4(g)} + Cl_{2(g)} \xrightarrow[sunlight]{diffused} CH_3Cl_{(g)} + HCl_{(g)}$$

Chloromethane

$$CH_3-Cl_{(g)} + Cl_{2(g)} \xrightarrow[sunlight]{diffused} CH_2Cl_{2(g)} + HCl_{(g)}$$

Dichloromethane

$$CH_2-Cl_{2(g)} + Cl_{2(g)} \xrightarrow[sunlight]{diffused} CHCl_{3(g)} + HCl_{(g)}$$

Trichloromethane (Chloroform)

$$CHCl_{3(g)} + Cl_{2(g)} \xrightarrow[sunlight]{diffused} CCl_{4(g)} + HCl_{(g)}$$

Carbontetrachloride (Tetrachloromathene)

(iii) Ethene into glycol

$$3CH_2=CH_2 + 2KMnO_4 + 4H_2O \longrightarrow 3CH_2(OH)-CH_2(OH) + 2MnO_2 + 2KOH$$

Ethene → Ethylene Glycol

(iv) Ethyl chloride into ethane

$$CH_3-CH_2 + 2[H] \xrightarrow[HCl_{(aq)}]{Zn} CH_3-CH_3 + HCl$$

(v) Ethyl bromide into ethene

$$CH_3-CH_2(Br) + KOH \xrightarrow{Alcohol} \underset{ethene}{CH_2=CH_2} + KBr + H_2O$$

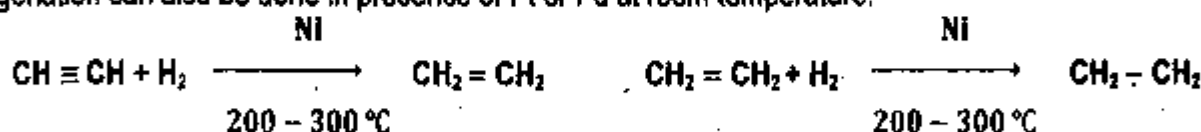
(vii) Write a chemical equation to show the preparation of an alkane from an alkene and an alkyne.

Ans: Preparations of Alkanes:

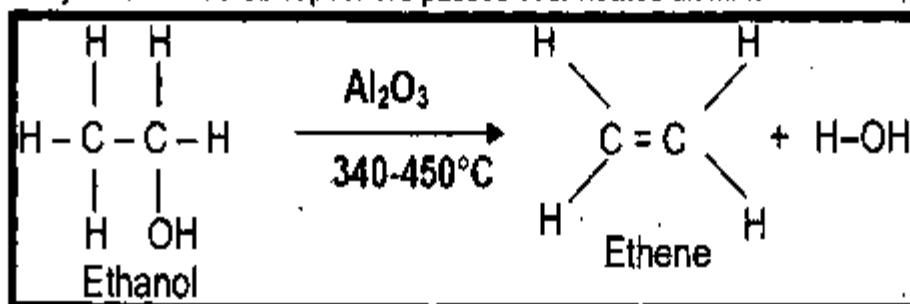
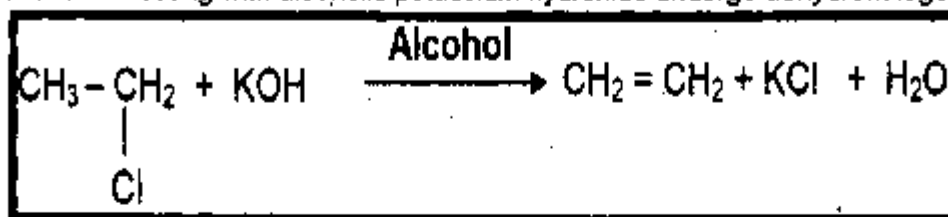
By Hydrogenation of alkenes and alkynes:

Addition of hydrogen molecule across carbon-carbon multiple-bonds is called hydrogenation.

Hydrogenation takes place in presence of finally divided nickel at **200-300°C** and high pressure. Hydrogenation can also be done in presence of Pt or Pd at room temperature.

$$CH\equiv CH + H_2 \xrightarrow[200-300\,^\circ C]{Ni} CH_2=CH_2 \qquad CH_2=CH_2 + H_2 \xrightarrow[200-300\,^\circ C]{Ni} CH_3-CH_3$$

(viii) Write a chemical equation to show the preparation of ethene from dehydration of an alcohol and dehydrohalogenation of alkyl halides.

Ans: Preparation of ethene:

1. **By Dehydration of Alcohols:** Dehydration means loss of water.
Alcohols dehydrate when their vapour are passed over heated alumina.

2. **By dehydrohalogenation of alkyl halides:** Dehydrohalogenation means loss of hydrogen halide.
Alkyl halides on heating with alcoholic potassium hydroxide undergo dehydrohalogenation.

$$CH_3-CH_2(Cl) + KOH \xrightarrow{Alcohol} CH_2=CH_2 + KCl + H_2O$$

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

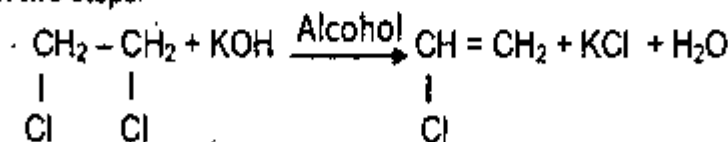
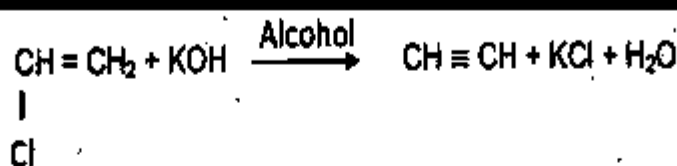
(i) Write a chemical equation to show the preparation of ethyne from dehalogenation of 1, 2-dihalide and a tetrahalide.

Ans: Preparation of ethyne:

1. **By Dehydrohalogenations of 1, 2 - dihalide:**

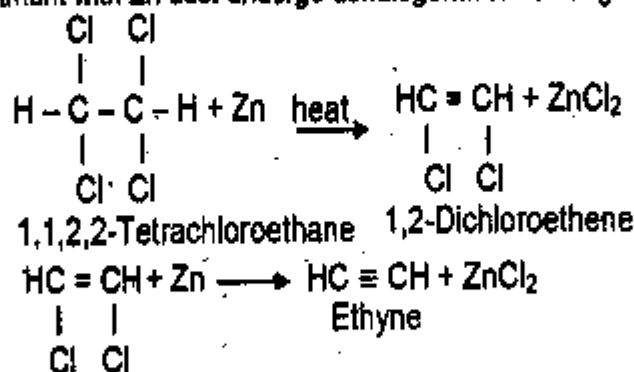
Vicinal dihalide on treatment with alcoholic potassium hydroxide eliminates two molecules of hydrogen halides from adjacent carbon atoms. Removal of two molecules forms a triple bond between two carbon atoms. Reaction occurs in two steps.

$$CH_2(Cl)-CH_2(Cl) + KOH \xrightarrow{Alcohol} CH(Cl)=CH_2 + KCl + H_2O$$

$$\underset{\displaystyle Cl}{\overset{|}{CH}} = CH_2 + KOH \xrightarrow{\text{Alcohol}} CH \equiv CH + KCl + H_2O$$

2. **By Dehalogenation of Tetrahalides:**

Tetra halides on treatment with Zn dust undergo dehalogenation forming an alkyne.

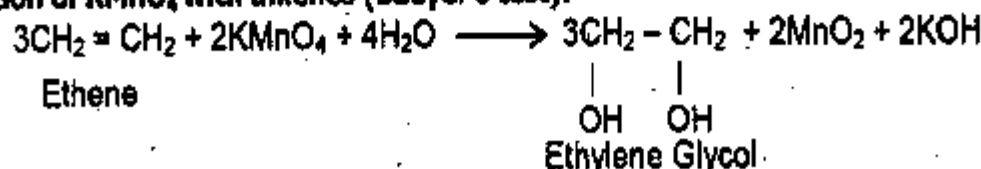
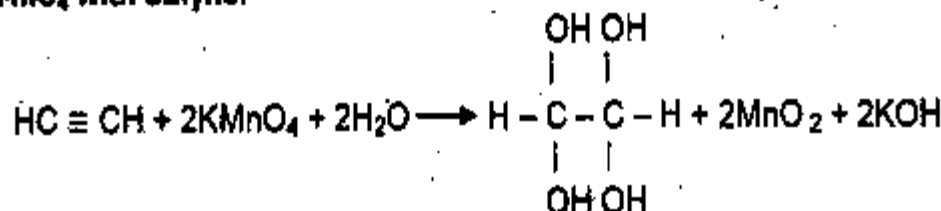
$$\underset{\text{1,1,2,2-Tetrachloroethane}}{H - C(Cl)_2 - C(Cl)_2 - H} + Zn \xrightarrow{\text{heat}} \underset{\text{1,2-Dichloroethene}}{HC(Cl) = CH(Cl)} + ZnCl_2$$

$$HC(Cl) = CH(Cl) + Zn \longrightarrow \underset{\text{Ethyne}}{HC \equiv CH} + ZnCl_2$$

(ii) Write chemical equations showing reaction of $KMnO_4$ with ethene and ethyne.

Ans: Reaction of $KMnO_4$ with alkenes (Baeyer's test):

$$\underset{\text{Ethene}}{3CH_2 = CH_2} + 2KMnO_4 + 4H_2O \longrightarrow \underset{\text{Ethylene Glycol}}{3CH_2(OH) - CH_2(OH)} + 2MnO_2 + 2KOH$$

Reaction of $KMnO_4$ with ethyne:

$$HC \equiv CH + 2KMnO_4 + 2H_2O \longrightarrow H - C(OH)_2 - C(OH)_2 - H + 2MnO_2 + 2KOH$$

(iii) List some industrial uses of ethene and ethyne.

Ans: Industrial uses of ethene:

Ethene has two main industrial uses, ethene is used to accelerate the ripening of fruits and is most commonly used on bananas and also on citrus fruits. The other use of ethene is in the manufacture of plastics, such as packing films, wire coatings, and squeeze bottles.

Industrial uses of Ethyne (Acetylene): Ethyne is used:

(i) In oxy-acetylene torch for welding and cutting metals. **(ii)** For ripening of fruits.

(iii) For the manufacture of polyvinyl acetate (PVA), polyvinyl chloride (PVC), polyvinyl ethers and rubber.

(iv) Describe the trends in reactivity of halogen with alkanes?

Ans: The trends in reactivity of halogen with alkanes are as follows ; $F_2 > Cl_2 > Br_2 > I_2$

Fluorine reacts explosively; chlorine reacts slowly in dark at room temperature but rapidly in strong sun light. Bromine is less reactive than chlorine and requires high temperature or strong sun light. Iodine is essentially unreactive.

(v) Draw electron dot and cross structure for

(a) Propane **(b) Propyne** **(c) Propene**

Ans:

(a) Propane	(b) Propyne	(c) Propene
H H H x x x H x· C ·· C ·· C ·xH	H H x x C ⁝⁝ C ·· C ·xH	H H H x x x C :: C ·· C ·xH

(vi) What do you understand by the combustion of methane?

Ans: Combustion:

A reaction of a substance with oxygen or air that causes the rapid release of heat and the appearance of a flame is called combustion. Complete combustion of alkanes produces carbondioxide, water and heat. Most of them burn with blue flame.

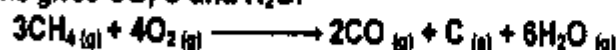
For example, following reaction occurs when natural gas is burned.

$$CH_{4(g)} + 2O_{2\,(g)} \longrightarrow CO_{2\,(g)} + 2H_2O_{\,(g)} + \text{heat}$$

The lighter alkanes are widely used as fuels. This is because:

(i) Their combustion can be controlled.
(ii) They produce large amount of heat per gram.
(iii) They are cheap and readily available.

Incomplete combustion occurs in presence of limited supply of oxygen. Incomplete combustion of methane gives **CO, C and H_2O.**

$$3CH_{4\,(g)} + 4O_{2\,(g)} \longrightarrow 2CO_{\,(g)} + C_{\,(s)} + 6H_2O_{\,(g)}$$

(vii) List some properties of Alkanes?

Ans: Properties of Alkanes:

i. Alkane molecules are essentially non-polar.
Alkanes are less dense than water and are insoluble in it.

ii. Chemically alkanes are unreactive towards most ionic compounds. This lack of reactivity makes them useful solvents. For instance hexane is used to extract vegetable oils from Corn, Soya beans, Cotton seed etc.

iii. Alkanes containing up to four carbon atoms are colourless, odourless gases.

iv. Alkanes containing five to seventeen atoms are colourless, odourless liquids.

v. Higher alkanes are solids which are also colourless and odourless.

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. **(2 × 10 = 20)**

Q4. a. Differentiate between ethene and athyne.

Solution: Two tests to distinguish ethene and ethyne are:-

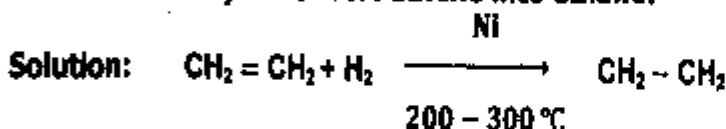
(i) ammonical silver nitrate test ⟶ with ammonical silver nitrate solution (tollens reagent) alkyne gives a white precipitate but alkene does not.

For example: **ethyne + tollens reagent ⟶ silver acetylide (white ppt) + NH_3 + H_2O**
ethene + tollens reagent ⟶ no reaction

(ii) ammonical cuprous chloride test ⟶ with an ammonical cuprous chloride, alkyne gives a red precipitate while alkene does not react

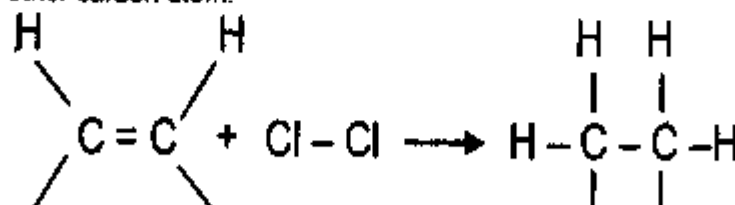
For example: **ethyne + ammonical cuprous chloride ⟶ copper acetylide (red ppt) + NH_3 + H_2O**
ethene + ammonical cuprous chloride ⟶ no reaction

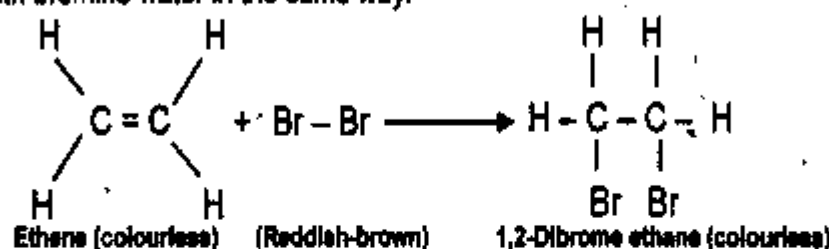
b. How can you convert ethene into ethane?

Solution: $$CH_2 = CH_2 + H_2 \xrightarrow[200-300\,^\circ C]{Ni} CH_3 - CH_3$$

Q5. a. Write chemical equations showing reactions of alkenes with halogens?

Ans: Reactions of alkenes with halogens (Addition reactions):

i. Chlorine and bromine add to the double bond. One chlorine atom becomes attached with one carbon and the one with other carbon atom.

$$H_2C=CH_2 + Cl-Cl \longrightarrow H-\underset{|}{\overset{H}{\overset{|}{C}}}-\underset{|}{\overset{H}{\overset{|}{C}}}-H$$

ii. Test for the presence of unsaturation:

Alkenes react with bromine water in the same way.

Ethene (colourless) (Reddish-brown) 1,2-Dibromo ethane (colourless)

Bromine is a reddish-brown liquid and the product is colourless. When bromine water is added to an alkene, the red-brown color disappears. The decolourization of bromine solution is frequently used as a simple test for the presence of unsaturation.

b. List the properties of alkynes?

Ans: Properties of Alkynes:

i. Like alkenes, alkynes are also unsaturated hydrocarbons.
ii. The first three members are gases, next eight members are liquids and higher members are solids.
iii. They are non-polar and dissolve readily in organic solvents.
iv. Ethyne has garlic like odour.
v. Alkynes are reactive compounds due to presence of a triple bond. Alkynes undergo addition reaction across the triple bond.
vi. One molecule adds across the double bond in an addition reaction.
vii. Alkynes also undergo addition reactions like alkene.

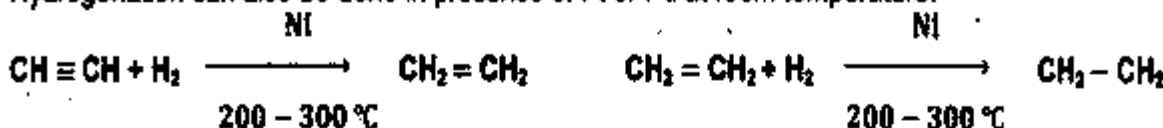
Q6. a. Write a chemical equation to show the preparation of an alkane from an alkene and an alkyne.

OR Write a chemical equation to show the preparation of alkanes from hydrogenation of alkenes and alkynes and from reduction of alkyl halides?

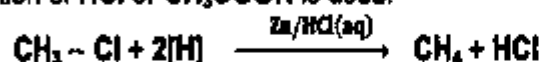
Ans: General Methods of Preparations of Alkanes:

i. By Hydrogenation of alkenes and alkynes:

Addition of hydrogen molecule across carbon-carbon multiple-bonds is called hydrogenation.
Hydrogenation takes place in presence of finaly divided nickel at 200-300 °C and high pressure.
Hydrogenation can also be done in presence of Pt or Pd at room temperature.

$$CH \equiv CH + H_2 \xrightarrow[200-300\,°C]{Ni} CH_2 = CH_2 \qquad CH_2 = CH_2 + H_2 \xrightarrow[200-300\,°C]{Ni} CH_3 - CH_3$$

ii. By the reduction of alkyl halides:

When an alkyl halide is treated with **Zn** in presence of an aqueous acid, an alkane is produced. Usually aqueous solution of **HCl** or **CH_3COOH** is used.

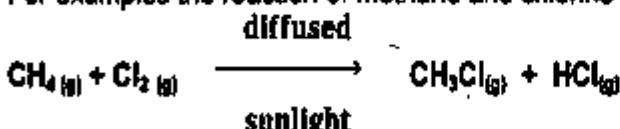
$$CH_3 - Cl + 2[H] \xrightarrow{Zn/HCl(aq)} CH_4 + HCl$$

Zn reacts with aqueous acid to liberate atomic hydrogen called nascent hydrogen. Nascent hydrogen reduces alkyl halide. Addition of nascent hydrogen is called reduction.

b. What happens when Methane is treated with chlorine in the presence of diffused sun light?

OR What do you understand by the halogenation?

OR Write chemical equation showing reaction of chlorine with hydrocarbons?

Ans: Halogenation:

Substitution reaction: The reaction of an alkane and a halogen is a **substitution reaction**.
In this reaction a halogen atom substitutes for one or more of the hydrogen atoms of an alkane.
For examples the reaction of methane and chlorine in diffused sunlight occurs as follows.

$$CH_{4(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CH_3Cl_{(g)} + HCl_{(g)}$$

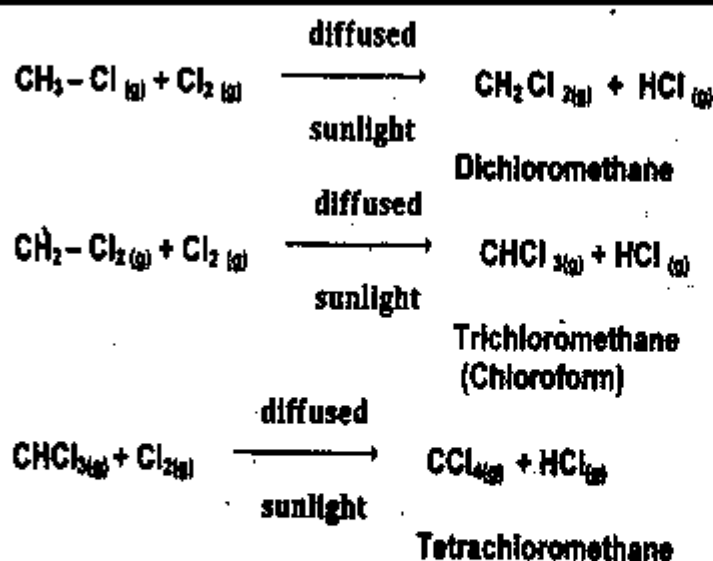
$$CH_3-Cl_{(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CH_2Cl_{2(g)} + HCl_{(g)}$$

Dichloromethane

$$CH_2-Cl_{2(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CHCl_{3(g)} + HCl_{(g)}$$

Trichloromethane (Chloroform)

$$CHCl_{3(g)} + Cl_{2(g)} \xrightarrow[\text{sunlight}]{\text{diffused}} CCl_{4(g)} + HCl_{(g)}$$

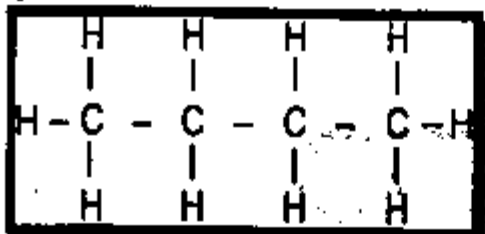
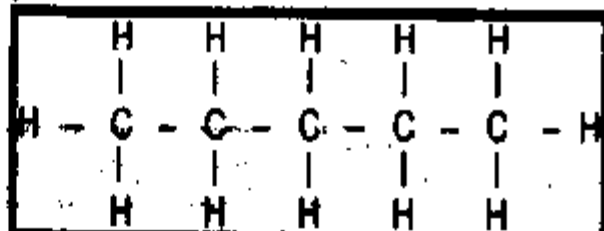
Tetrachloromethane

Important Questions & Answers (Reduced Syllabus)

Self-Assessment Exercise 12.1

◆ Write structural formulas for (a) Butane (b) Pentane

Solution:

(a) **Butane:**

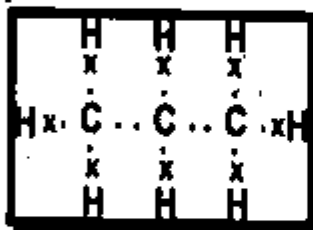
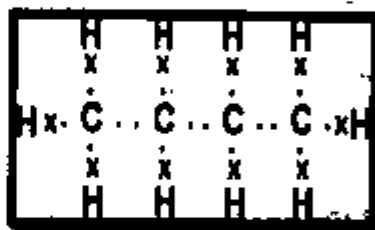
```
    H   H   H   H
    |   |   |   |
H - C - C - C - C - H
    |   |   |   |
    H   H   H   H
```

(b) **Pentane:**

Self-Assessment Exercise 12.2

◆ Draw electron dot and cross structures for the following. (a) Propane (b) Butane

Solution:

(a) **Propane:**

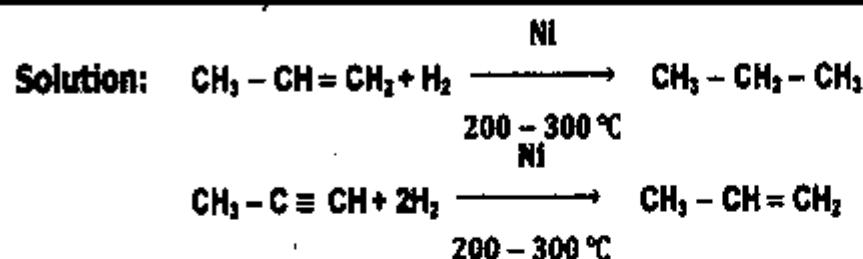
(b) **Butane:**

```
   H    H    H    H
   x    x    x    x
   .    .    .    .
Hx.C .. C .. C .. C.xH
   .    .    .    .
   x    x    x    x
   H    H    H    H
```

Self-Assessment Exercise 12.3

◆ Complete the following reactions

Ni Ni

Solution: $CH_3-CH=CH_2+H_2 \xrightarrow[200-300\,°C]{Ni} CH_3-CH_2-CH_3$

$CH_3-C\equiv CH+2H_2 \xrightarrow[200-300\,°C]{Ni} CH_3-CH=CH_2$

Self-Assessment Exercise 12.4

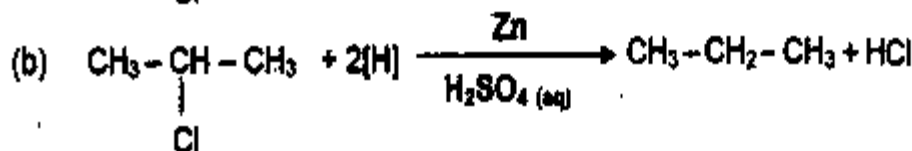
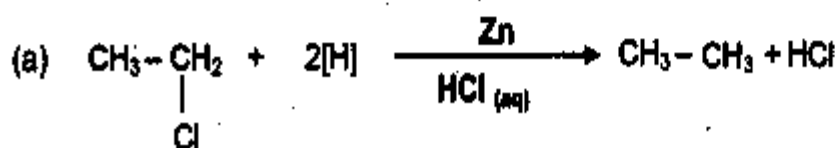
- **Complete the following reactions.**

(a) $CH_3-CH_2(Cl) + 2[H] \xrightarrow[HCl_{(aq)}]{Zn}$

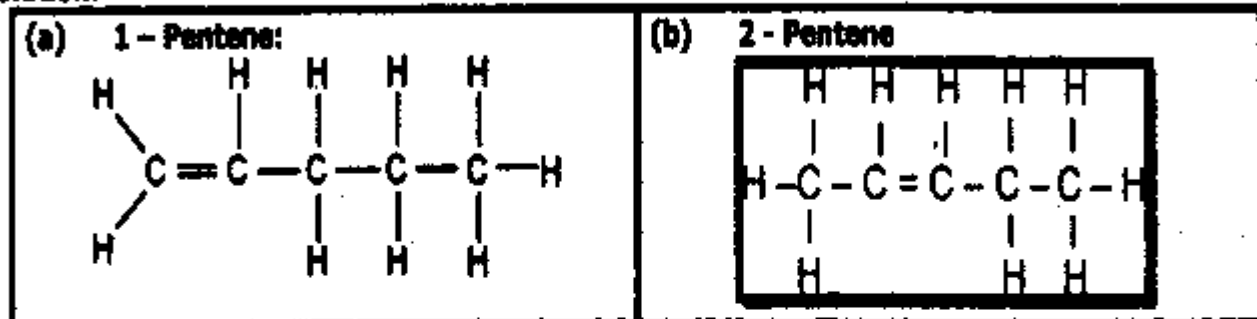
(b) $CH_3-CH(Cl)-CH_3 + 2[H] \xrightarrow[H_2SO_{4\,(aq)}]{Zn}$

Solution:

(a) $CH_3-CH_2(Cl) + 2[H] \xrightarrow[HCl_{(aq)}]{Zn} CH_3-CH_3+HCl$

(b) $CH_3-CH(Cl)-CH_3 + 2[H] \xrightarrow[H_2SO_{4\,(aq)}]{Zn} CH_3-CH_2-CH_3+HCl$

Self-Assessment Exercise 12.5

- **Draw structural formulae for the following compounds. (a) 1 - Pentene (b) 2 - Pentene**

Solution:

Self-Assessment Exercise 12.6

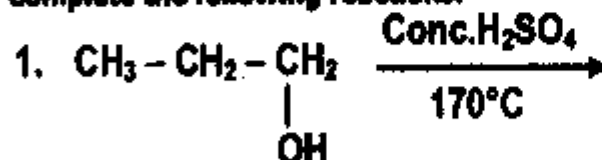
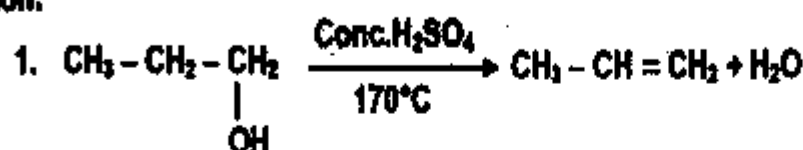
- **Complete the following reactions.**

1. $CH_3-CH_2-CH_2(OH) \xrightarrow[170°C]{Conc.H_2SO_4}$

2. $CH_3-CH_2-CH_2 + KOH \xrightarrow{Alcohol}$

Solution:

1. $CH_3-CH_2-CH_2(OH) \xrightarrow[170°C]{Conc. H_2SO_4} CH_3-CH=CH_2 + H_2O$

2. $CH_3-CH_2-CH_2(Br) + KOH \xrightarrow{Alcohol} CH_3-CH=CH_2 + KBr + H_2O$

Self-Assessment Exercise 12.7

- **Complete the following reactions:**
  1. $CH_3-CH=CH_2 + Br_2 \longrightarrow$
  2. $CH_3-CH=CH_2 + KMnO_4 + H_2O \longrightarrow$
  3. $CH_3-CH=CH_2 + Cl_2 \longrightarrow$

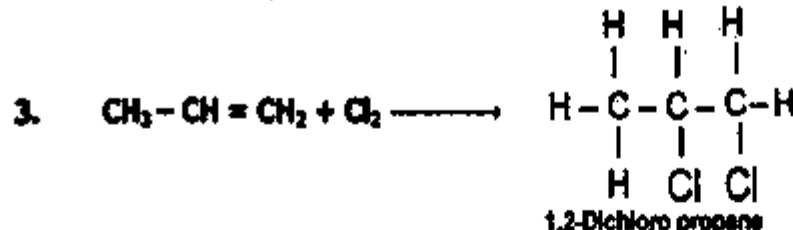
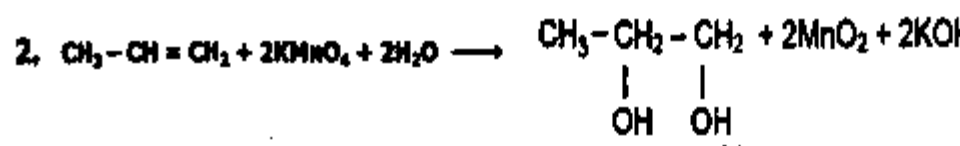
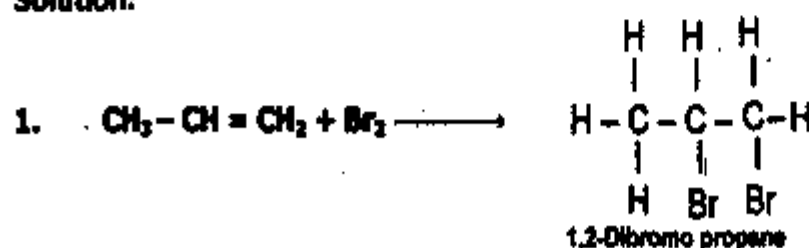
Solution:

1. $CH_3-CH=CH_2 + Br_2 \longrightarrow H-C(H)(H)-C(H)(Br)-C(H)(Br)-H$

   1,2-Dibromo propane

2. $CH_3-CH=CH_2 + 2KMnO_4 + 2H_2O \longrightarrow CH_3-CH(OH)-CH_2(OH) + 2MnO_2 + 2KOH$

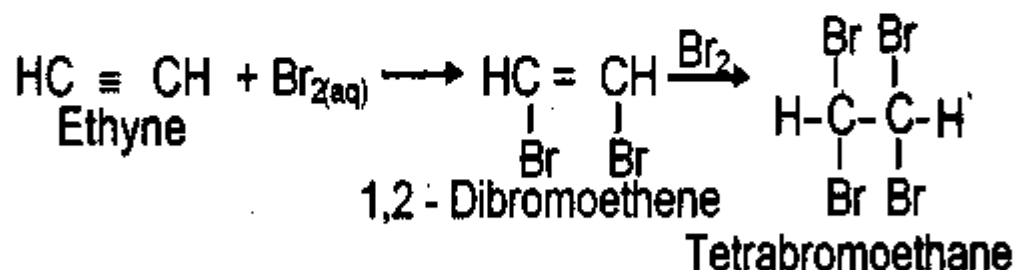
3. $CH_3-CH=CH_2 + Cl_2 \longrightarrow H-C(H)(H)-C(H)(Cl)-C(H)(Cl)-H$

   1,2-Dichloro propane

Self-Assessment Exercise 12.8

- **Write chemical reaction of ethyne and bromine. Why this reaction is used to identify the unsaturation in a molecule?**

$$HC\equiv CH + Br_{2(aq)} \longrightarrow A \xrightarrow{Br_2} B$$

Solution:

$$\underset{\text{Ethyne}}{HC\equiv CH} + Br_{2(aq)} \longrightarrow \underset{\text{1,2 - Dibromoethene}}{HC(Br)=CH(Br)} \xrightarrow{Br_2} \underset{\text{Tetrabromoethane}}{H-C(Br)(Br)-C(Br)(Br)-H}$$

Identify the unsaturation in a molecule:

Bromine is a reddish-brown liquid and the product is colourless. When bromine water is added to an

Self-Assessment Exercise 12.9

- **Complete the following reactions**

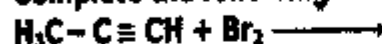
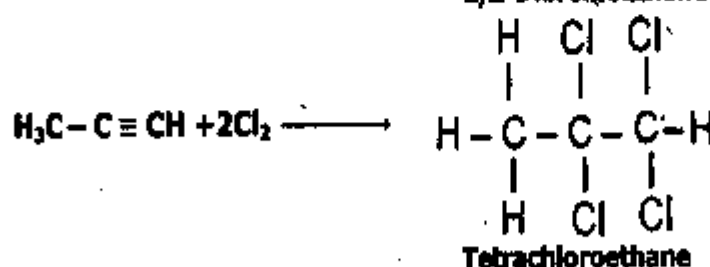
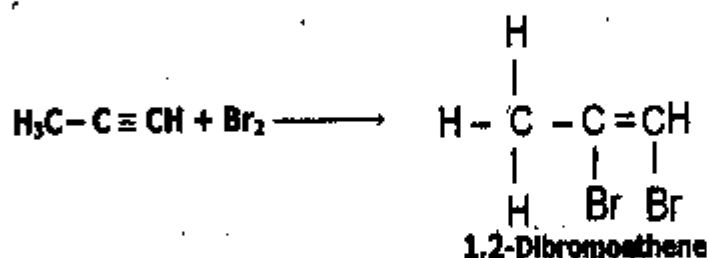
$H_3C-C\equiv CH + Br_2 \longrightarrow$ $H_3C-C\equiv CH + 2Cl_2 \longrightarrow$

Solution:

$$H_3C-C\equiv CH + Br_2 \longrightarrow H-\underset{H}{\overset{H}{|}}{C}-\underset{Br}{C}=\underset{Br}{CH}$$

1,2-Dibromoethene

$$H_3C-C\equiv CH + 2Cl_2 \longrightarrow H-\underset{H}{\overset{H}{C}}-\underset{Cl}{\overset{Cl}{C}}-\underset{Cl}{\overset{Cl}{C}}-H$$

Tetrachloroethane

Q1. Define hydrocarbons?

Ans: Hydrocarbons: The organic compounds which contain only two elements, carbon and hydrogen are called hydrocarbons.

Q2. List the uses of methane?

Ans: Uses of methane: Methane is used

(i) as domestic fuel (Sui gas). (ii) as a fuel for automobiles (CNG).

(iii) to manufacture urea fertilizer.

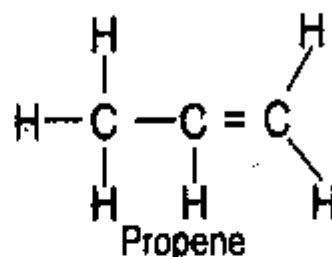
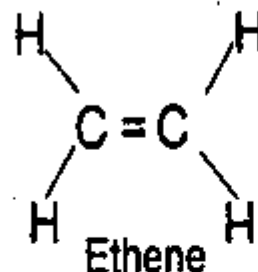
Q3. What are alkenes? Draw structure of simple alkenes.

Ans: Alkenes:

Alkenes have one or more double bond between carbon atoms. They have the general formula C_nH_{2n}. When two carbon atoms share two pairs of electrons, they form a double bond between the carbon atoms. How many electrons are left on each carbon atoms? Doubly bonded carbon atoms form single bond with two other atoms.

$$\underset{H}{\overset{H}{}}\!\!>C=C<\!\!\underset{H}{\overset{H}{}}$$

Ethene

$$H-\underset{H}{\overset{H}{C}}-\underset{H}{C}=C<\!\!\underset{H}{\overset{H}{}}$$

Propene

Q4. List the properties of alkenes?

Ans: Properties of Alkenes:

i. Alkenes are unsaturated hydrocarbons.

ii. First three members i.e. ethene, propene and butene are gases while C_5-C_{16} members are liquids and the higher members are solids.

iii. They are insoluble in water but soluble in organic solvents such as alcohol etc.

iv. The two carbons atoms forming double bond are joined to only three atoms.

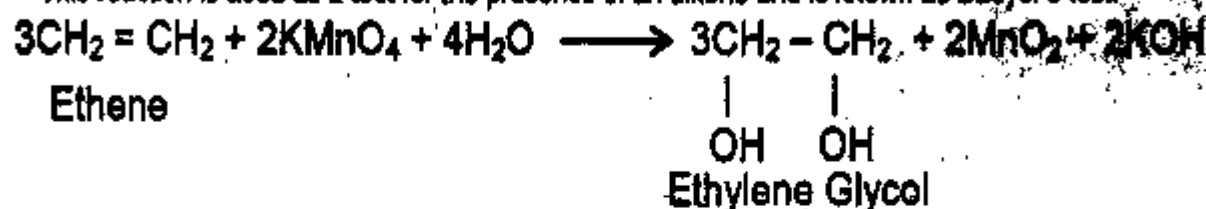
v. Since a carbon atom can join to four atoms. So other molecules can attack at this site of double bond.

Q5. Write chemical equation showing reaction of $KMnO_4$ with, alkenes?

OR

What do you understand by Baeyer's test?

This reaction is used as a test for the presence of an alkene and is known as Baeyer's test.

$$\underset{\text{Ethene}}{3CH_2 = CH_2} + 2KMnO_4 + 4H_2O \longrightarrow \underset{\text{Ethylene Glycol}}{3\underset{|}{\underset{OH}{CH_2}} - \underset{|}{\underset{OH}{CH_2}}} + 2MnO_2 + 2KOH$$

Note: Ethylene glycol is used as an anti-freeze.

Q6. What are alkynes? Draw the structure of acetylene?

Ans: Alkynes:

Hydrocarbons which have at least one triple bond between carbon atoms are called alkynes. Those with one triple bond have the general formula C_nH_{2n-2}.

Structure acetylene:

Ethyne also called acetylene is the simplest member of alkyne family. In ethyne the two carbon atoms share three pairs of electrons. This means the carbon atoms are joined by a triple bond.

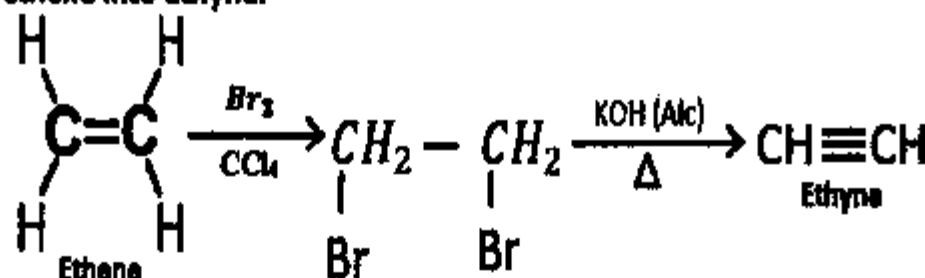
Structure of ethyne is $H-C\equiv C-H$

Q7. Construct a scheme to convert ethene into ethyne?

Solution: Step to convert ethene to Ethyne:

i. **Ethane is characterized by the chemical formula C_2H_4.**
ii. It is made to react with Br_2 in the presence of CCl_4 as catalyst.
iii. The 2 atoms of Br attaches to the ethane and forms Dibromoethane.
iv. It is then heated in the presence of *alcoholic KOH*.
v. This process yields *ethyne* as the end product.

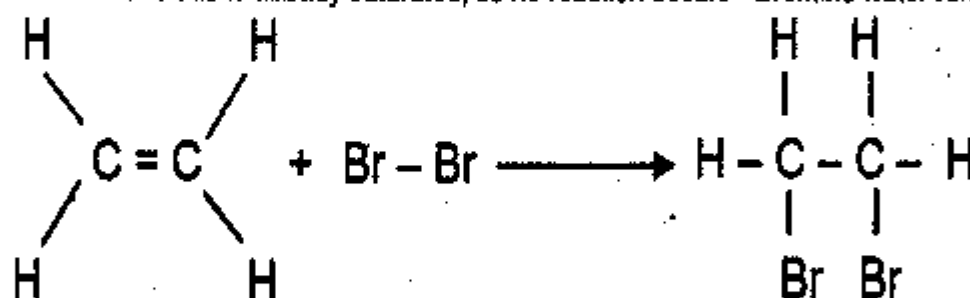
Conversion of ethene into ethyne:

$$\underset{\text{Ethene}}{H_2C=CH_2} \xrightarrow[CCl_4]{Br_2} \underset{Br}{CH_2} - \underset{Br}{CH_2} \xrightarrow[\Delta]{KOH(Alc)} \underset{\text{Ethyne}}{CH\equiv CH}$$

Q8. You are given two flammable liquid hydrocarbons. One of them is an alkene and the other is an alkane. How would you find out which is which?

Ans: Add a small amount of bromine water to each jar. Shake the jar containing alkene will decolour the bromine water. The jar containing the alkane the bromine water will remain brown.

This is because the Br_2 will add on across the double bond of the unsaturated ethene to produce dibromoethane. The Br_2 is removed from the water which becomes clear.

In the case of ethane this is already saturated, so no reaction occurs - Bromine water remains brown

$$H_2C=CH_2 + Br-Br \longrightarrow H-\underset{Br}{\overset{H}{C}}-\underset{Br}{\overset{H}{C}}-H$$

GUESS PAPER & MODEL PAPER # 05
BASED ON CHAPTER # 13 (Reduced Syllabus)
BIOCHEMISTRY

CHAPTER 13 : BIOCHEMISTRY

Topics: Carbohydrates and its types, sources and uses of carbohydrates, nucleic acid, DNA, RNA, Vitamin and Types of Vitamin.

Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

i. Strand of RNA is made of
A. ribose sugar B. phosphate unit C. nitrogen base D. all of above

ii. Plants convert glucose into
A. starch B. lipids C. proteins D. amino acids

iii. Glucose is a
A. tetrose B. pentose C. disaccharide D. hexose

iv. Which is not a dextrose sugar
A. glucose B. mannose C. galactose D. fructose

v. Which of the following are obtained from fruits, vegetables, and cereals?
A. sucrose B. monosaccharides C. cellulose D. starch

vi. Which is not a source of starch?
A. wheat B. rice C. cotton D. potato

vii. The general formula of Monosaccharides is
A. $C_nH_{2n}^{+2}$ B. C_nH_2 C. C_nH_{2n} D. $(CH_2O)_n$

viii. Which of the following causes dry skin when taken in excess amount?
A. vitamin A B. vitamin B C. vitamin C D. vitamin D

ix. Which is not present in DNA
A. deoxyribose sugar B. ribose sugar
C. phosphate unit D. nitrogen base

x. Raffinose $C_{18}H_{32}O_{16}$ is a
A. monosaccharide B. disaccharide
C. oligosaccharide D Polysaccharide

xi. Deficiency of vitamin A causes
A. night blindness B. anemia and bleeding gums
C. scurvy D. rickets and Osteomalacia

xii. Which of the following is true about DNA?
A. it is present in cell nucleus

CHEMISTRY SSC-II

Time allowed: 2:40 hours — Total Marks: 53

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

i. Decide, whether sucrose is a disaccharide or monosaccharide. Give reason.
ii. What is a dextrose sugar?
iii. What is a peptide bond?
iv. What is the function of DNA?
v. Distinguish between mono, di-, and tri-saccharides. Give examples.
vi. Give sources and uses of carbohydrates.
vii. Define and explain vitamins.
viii. Distinguish between DNA and RNA?

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

i. Describe the importance of nucleic acids.
ii. Explain the use of dextrose in drips.
iii. Separate water soluble vitamins from the following.
Vitamin A, Vitamin C, Vitamin E, Vitamin B
iv. Define carbohydrates. How do plants prepare carbohydrates?
v. What is the structure and function of RNA?
vi. Give the Sources and uses of vitamins A, B, C, D, E and K
vii. Who discover the structure of DNA?

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q4. a. Define vitamins. What are types of vitamins and explain them.
b. What is the chemical nature of oligosaccharides? Discuss their structure?

Q5. a. What is the structure and function of DNA?
b. What is the chemical nature of monosaccharides? Discuss their structure?

Q6. a. Describe the importance of nucleic acids.
b. Give the introduction of vitamins?
c. Is glucose a pentose?

SOLUTION OF GUESS PAPER & MODEL PAPER # 5
(Reduced Syllabus)

SECTION- A (MCQs)

i. D	ii. A	iii. D	iv. D	v. B	vi. D
vii. D	viii. A	ix. B	x. C	xi. A	xii. A

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks.

(which we call table sugar, cane sugar, or "sugar" itself). Sucrose is a disaccharide of glucose and fructose.

ii. What is a dextrose sugar?

Ans: Dextro-rotatory or dextrose sugars:

Some monosaccharide molecules can rotate the plane of plane polarized light to right (clockwise). They are called dextro-rotatory or dextrose sugars.

Glucose, manose, galactose are dextrose sugars.

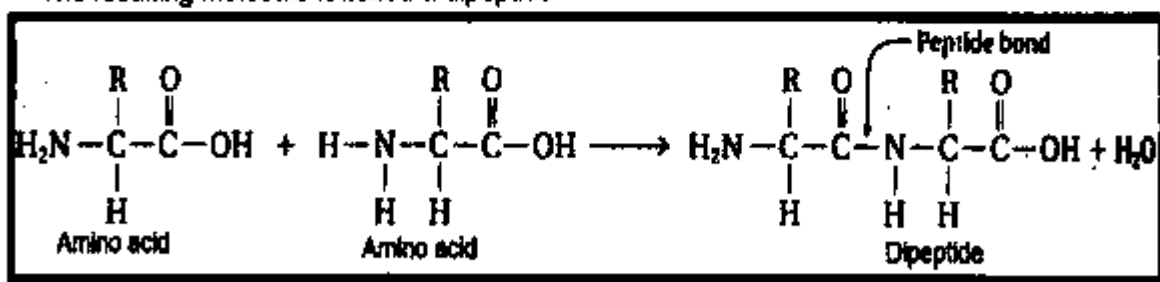
iii. What is a peptide bond?

Ans: Peptide bond:

The linkage $-\overset{\overset{\large O}{\|}}{C}-NH-$ which joins two amino acid units is called a **peptide bond.**

The resulting molecule is called a dipeptide.

$$\underset{\text{Amino acid}}{H_2N-\underset{H}{\overset{R}{C}}-\overset{O}{\overset{\|}{C}}-OH} + \underset{\text{Amino acid}}{H-\underset{H}{N}-\underset{H}{\overset{R}{C}}-\overset{O}{\overset{\|}{C}}-OH} \longrightarrow \underset{\text{Dipeptide}}{H_2N-\underset{H}{\overset{R}{C}}-\overset{O}{\overset{\|}{C}}-\underset{H}{N}-\underset{H}{\overset{R}{C}}-\overset{O}{\overset{\|}{C}}-OH} + H_2O$$

Peptide bond

iv. What is the function of DNA?

Ans: Function of DNA:

DNA can store and transmit all the genetic information needed to build organisms. For instance, in human beings, the single fertilized egg cell carry the information for making legs, hands, head, liver, heart, kidneys etc. DNA is found primarily in the cell nucleus.

The key to the ability of DNA to store genetic information and to pass it on from generation to generation is its double stranded structure.

v. Distinguish between mono, di-, and tri-saccharides. Give examples.

Ans: Monosaccharide:

Monosaccharide is a simple sugar consists of only one unit. They serve as building blocks for more complex carbohydrate forms.

Example: Some important monosaccharides include:

i. Glucose **ii.** Fructose **iii.** Galactose **iv.** Lyxose **v.** Xylose

Disaccharides:

Disaccharides are a group of sugars composed of two monosaccharide groups linked together through the loss of sugar.

Example: Some important disaccharides include:

i. Maltose = Glucose + Glucose **ii.** Sucrose = Glucose + Fructose

iii. Lactose = Glucose + Galactose

Trisaccharides: Trisaccharides are sugars containing three hexoses.

Examples: Raffinose, found in molasses contain the three hexoses. Nigerotriose Maltotriose Melezitose

vi. Give sources and uses of carbohydrates.

Ans: Sources of Carbohydrates:

Carbohydrates are the most abundant class of carbon containing compounds.

i. Monosaccharides:

Monosaccharides such as glucose, fructose and galactose are obtained from furits, vegetables and cereals. They are also present in honey.

ii. Disaccharide:

Disaccharide such as sucrose is obtained in sugarcane, sugar beet and fruits. Maltose is found in cereals. Lactose is main sugar in milk and dairy products.

iii. Cellulose: Cellulose is obtained from plants e.g. Cotton is pure cellulose.

Uses of Carbohydrates:

- i. Carbohydrates store and transport energy in both plants and animals. 1g of glucose provides us 15.6 KJ of energy.
- ii. They serve as food source for most organisms.
- iii. Carbohydrates serve as structural material for plants. Cellulose in the human diet is referred as fibre. It is found in bran, whole meal bread, fruit and vegetables. We cannot digest it but it is very important for us. It helps the muscles of your intestines to move food efficiently through the digestive track. It absorbs and carries away toxic chemicals in food that would otherwise harm us. It also helps in lowering cholesterol and regulates blood pressure.
- iv. Sucrose in used as common table sugar.
- v. Glucose is stored in animal muscles and liver cells in the form of glycogen. Glycogen serves as long term energy reservoir. It can be converted back to glucose when needed for energy. Plants store excess energy as starch.
- vi. Starch is used to make rectified spirit by fermentation process.
- vii. Starch is converted to dextrin which is used as an adhesive for stamps and as wallpaper glue.
- viii. Cows, cattle, goats, deer, sheep and termites derive nutrition from cellulose.
- ix. We use cellulose in the form of wood for heat, housing and furniture.
- x. Wood is also used to make paper and wood pulp.
- xi. Cellulose fibre of cotton is used to make rayon and cellulose acetate, which are used in textile industry for making cloth.

vii. Define and explain vitamins.

Ans: Vitamins:

Vitamins are specific organic compounds which are required by our bodies to prevent specific diseases but cannot be produced by our bodies.

They must be present in our diet in addition to proteins, fats, carbohydrates and minerals.

Vitamin D deficiency causes softening of bones. Vitamin B_3 deficiency causes inflammation and abnormal pigmentation.

Importance of vitamins: Vitamins are substances that are essential for our bodies.

Vitamin A: Vitamin A is important in vision. It helps in the chemical transmission of images from the eye to the brain. It also keeps the cornea moist.

Vitamin C: Vitamin C is required for the formation of blood and boosting the immune system that protects against illnesses ranging from common cold to cancer.

Vitamin B: Vitamin B helps to regulate nerve impulse transmissions, in the formation of haemoglobin and activates more than 100 different enzymes.

Vitamin D: Vitamin D regulates blood calcium. It is necessary for proper bone and tooth growth.

viii. Distinguish between DNA and RNA?

Ans: There are two **differences** that **distinguish DNA** from RNA:

- **(a)** **RNA** contains the sugar ribose, while **DNA** contains the slightly **different** sugar deoxyribose (a type of ribose that lacks one oxygen atom).
- **(b)** **RNA** has the nucleobase uracil while **DNA** contains thymine.

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. **(5 × 3 = 15)**

i. Describe the importance of nucleic acids.

Ans: Importance of nucleic acids:

Nucleic acids are vital components of all life. They are found in every living cell. They serve as the information and control centers of the cell.

ii. Explain the use of dextrose in drips.

Ans: Use of dextrose in drips:

5% m/v aqueous solution of dextrose is used in drips...

iii. Separate water soluble vitamins from the following. Vitamin A, Vitamin C, Vitamin E, Vitamin B

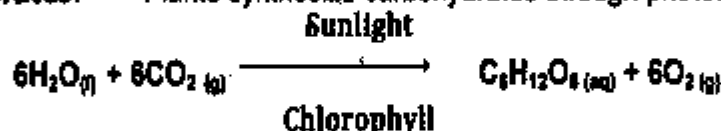
Ans: Water soluble vitamins: Vitamin A, Vitamin C, Vitamin B

iv. Define carbohydrates. How do plants prepare carbohydrates?

Ans: Carbohydrates:

Carbohydrates are the most abundant class of organic compounds. Carbohydrates have the general formula $C_x(H_2O)_y$. This formula suggests that they are hydrates of carbon with few exceptions.

Synthesis of Carbohydrates: Plants synthesize carbohydrates through photosynthesis.

$$6H_2O_{(l)} + 6CO_{2\,(g)} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_{6\,(aq)} + 6O_{2\,(g)}$$

Plants convert glucose into starch and cellulose. Carbohydrates are monomers and polymers of aldehydes and ketones that have numerous hydroxyl groups attached.

v. What is the structure and function of RNA?

Ans: Ribonucleic Acid (RNA):

RNA exists in the form of single strand. It is made of a ribose sugar, phosphate unit and nitrogen base. RNA is synthesized by DNA to transmit the genetic information. RNA is responsible for directing synthesis of new proteins.

Function of RNA:

RNA receives, reads, decodes and uses genetic information from DNA to synthesize new proteins.

vi. Give the Sources and uses of vitamins A, B, C, D, E and K

Ans: Sources, uses of vitamins and diseases due to their deficiency:

Vitamin	Sources	Necessary for	Deficiency symptoms
A	Milk, butter, fish oils eggs, fresh green vegetable	Eyes and skin	Night blindness, dry skin
B (a group of several vitamins)	Whole meal bread, rice, yeast liver, soybeans, fresh green vegetables	Energy production in cells, nerves, skin	Skin diseases, tongue inflammation, anemia, bleeding gums
C	Oranges, lemons Tomatoes fresh green vegetables.	Blood vessels, gums, healing wounds, preventing colds	Scurvy
D	Milk, butter, eggs, fish oils	Bones, teeth	Rickets, osteomalacia
E	Whole meal bread, rice eggs, butter, fresh green vegetables	Antioxidant	Hemolysis of red blood cells, sterility
K	Fresh green vegetables, liver	Clotting blood	Hemorrhage delayed blood clotting

vii. Who discover the structure of DNA?

Ans: Structure of DNA was discovered by **J. Watson and Francis Crick** in **1953**. They were awarded the **1962 Nobel Prize** for their work. This discovery initiated the field of molecular biology. Cancer research involves an extensive study of nucleic acids.

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. **(2 × 10 = 20)**

Q4. a. Define vitamins. What are types of vitamins and explain them.

Ans: Vitamins:

Vitamins are specific organic compounds which are required by our bodies to prevent specific diseases but cannot be produced by our bodies. They must be present in our diet in addition to proteins, fats, carbohydrates and minerals. Vitamin D deficiency causes softening of bones. Vitamin B_3 deficiency causes inflammation and abnormal pigmentation.

Harmful effects to use excess amount of vitamins:

Taking excess amount of fat soluble vitamins may be harmful.

For instance large excess of vitamin A can cause irritability, dry skin and feeling of pressure inside the head. Too much vitamin D can cause pain in bones, hard deposits in joints and kidneys, and weight loss.

(ii) Water soluble vitamins: A vitamin that dissolves in water is called water soluble vitamin.

Example: For example, vitamins B (complex) and C.

Note: Our body has limited capacity to store these vitamins. If taken in excess, these are readily excreted from the body. Water soluble vitamins are not toxic even if taken in excess.

b. What is the chemical nature of oligosaccharides? Discuss their structure?

Ans: Oligosaccharides:

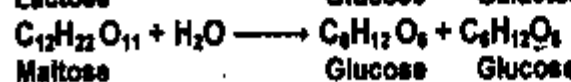
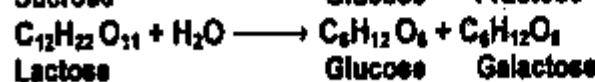
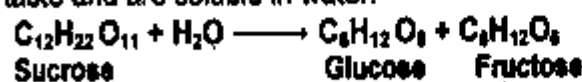
Carbohydrates which upon hydrolysis form 2 to 9 molecules of monosaccharides or simple sugars are called oligosaccharides.

Classification of oligosaccharides:

They are further clarified as disaccharides, trisaccharides etc. Prefixes di, tri, tetra, penta etc. indicate the number of monosaccharide units, they produce on hydrolysis. They are white crystalline solids. They have sweet taste and are soluble in water.

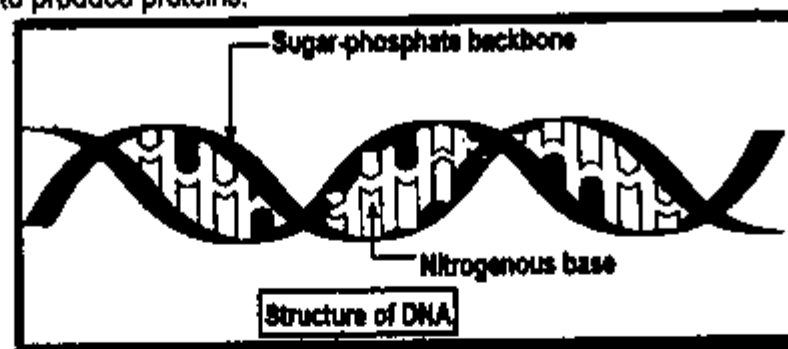
$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

$$\underset{\text{Lactose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Galactose}}{C_6H_{12}O_6}$$

$$\underset{\text{Maltose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Glucose}}{C_6H_{12}O_6}$$

Q5. a. What is the structure and function of DNA?

Ans: Deoxyribonucleic Acid (DNA):

DNA exists in the form of two strands twisted around each other in a spiral formation called a double helix. Each chain or strand is made up of a deoxyribose sugar, phosphate unit and a nitrogen base. The strands are held together by hydrogen bonds. The order of the base pairs in a strand is a code that stores information which is used to produce proteins.

Structure of DNA

Function of DNA:

i. The key ability of DNA to store genetic information.
ii. Pass genetic information from generation to generation.
iii. The order of the base pairs in a strand is a code that stores information which is used to produce proteins.

Function of DNA:

DNA can store and transmit all the genetic information needed to build organisms. For instance, in human beings, the single fertilized egg cell carry the information for making legs, hands, head, liver, heart, kidneys etc. DNA is found primarily in the cell nucleus.

b. What is the chemical nature of monosaccharides? Discuss their structure?

Ans: Monosaccharides: Monosaccharides are the simplest carbohydrates. They cannot be hydrolyzed.

General formula of monosaccharides:

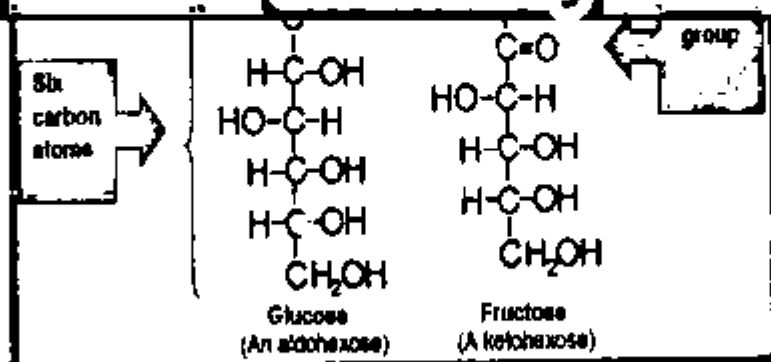
They have general formula $(CH_2O)_n$ where n is 3 to 6 carbon atoms. So monosaccharides contain 3 to

This classification is based on the number of carbon atoms they contain.

Aldehyde group

Ketone group

Six carbon atoms

Glucose (An aldohexose) Fructose (A ketohexose)

Glucose and fructose:

The two most familiar monosaccharides are glucose and fructose. Both have molecular formula $C_6H_{12}O_6$. Glucose is a pentahydroxy aldehyde, whereas fructose is apentahydroxy ketone. Their open chain structures are as follows. They are called simple sugars.

Dextro-rotatory or dextrose sugars:

Some monosaccharide molecules can rotate the plane of plane polarized light to right (clockwise). They are called dextro-rotatory or dextrose sugars.

Glucose, manose, galactose are dextrose sugars.

Characteristics of monosaccharides:

Monosaccharides are white crystalline solid. They are soluble in water and have sweet taste. They cannot be hydrolyzed. They are reducing in nature.

Q6. a. Describe the importance of nucleic acids.

Ans: Nucleic Acids:

Nucleic acids are large biological molecules essential for all known forms of life. They include DNA (deoxynbonucleic acid) and RNA (ribonucleic acid).

More than 100 years ago, a Swiss biochemist discovered a class of nitrogen-containing compounds in the nuclei of cells. These nitrogen-containing compounds which were first obtained from the pus of infected wounds are called nucleic acids.

Importance of nucleic acids:

Nucleic acids are vital components of all life. They are found in every living cell. They serve as the information and control centers of the cell.

Structure of nucleic acids:

They are long chain molecules made up of nucleotides. Each nucleotide consists of three components.

(i) Nitrogenous base. **(ii)** A pentose sugar or five carbon sugar **(iii)** Phosphate group.

Kinds of nucleic acids:

There are two kinds of nucleic acids, Deoxynbonucleic acid (DNA) and ribonucleic acid (RNA).

b. Give the introduction of vitamins?

Ans: Introduction of vitamins:

In 1897 the Dutch scientist C. Eijkman discovered that polished rice lacked something found in the hull. Lack of something caused the disease beriberi. A British scientist F.G Hopkins experimentally proved that in addition to carbohydrates, fats, proteins, and minerals, certain missing factors were also needed to sustain healthy growth. In 1912 Casmir Funk, Polish biochemist used the word 'vitamine' (from Latin word vita meaning life) for these missing factors. He thought all these factors contained the amino group. However, the

Important Questions & Answers (Reduced Syllabus)

Self-Assessment Exercise 13.1

1. **Classify sucrose, lactose and maltose as mono, di or tri-saccharides. Give reason.**

Ans: Since Sucrose consist of two monomers, therefore sucrose is a disaccharide. (which we call table sugar, cane sugar, or "sugar" itself). Sucrose is a disaccharide of glucose and fructose.
Maltose is a disaccharide of glucose and glucose.
Maltose = Glucose + Glucose
Lactose is a disaccharide of glucose and galactose.
Lactose = Glucose + Galactose

2. **Is galactose, a monosaccharide?**

Ans: Galactose is a monosaccharide because it cannot be hydrolyzed and consist of only one unit.

3. **Raffinose, $C_{18}H_{32}O_{16}$ hydrolyses as follows. Is raffinose a disaccharide?**

$$C_{18}H_{32}O_{16} + 2H_2O \longrightarrow 3C_6H_{12}O_6$$

Ans: **Examples:** Raffinose, found in molasses contain the three hexoses.
Therefore raffinose is a trisaccharides.

Self-Assessment Exercise 13.2

1. **List** a) **Three examples of monosaccharides.**
b) **Three examples of disaccharides**
c) **One example of trisaccharide**
d) **Two examples of polysaccharides**

2. **List sources of** a) **Sucrose** b) **Maltose** c) **Lactose**

Solution: 1. **List**

a) **Three examples of monosaccharides:** Glucose, Manose, Galactose, Fructose.
b) **Three examples of disaccharides:** Maltose, Lactose, Sucrose.
c) **One example of trisaccharide:** Isomaltotriose, Igerotriose, Maltotriose, Maltotriulose, Raffinose.
d) **Two examples of polysaccharides:** Cellulose, Glycogen, Starch.

2. **List sources of:**

a) **Sucrose:** Sucrose is obtained in sugarcane, sugar beet, honey and fruits.
b) **Maltose:** Maltose is found in cereals. It is also found in beverages, beer, cereal, pasta, potatoes.
c) **Lactose:** Lactose is main sugar in milk and dairy products.

Self-Assessment Exercise 13.5

1. **How do DNA and RNA differ in structure?**

Ans: **Deoxyribonucleic Acid (DNA):**

DNA exists in the form of two strands twisted around each other in a spiral formation called a **double helix**.

Each chain or strand is made up of a deoxyribose sugar, phosphate unit and a nitrogen base. The strands are held together by hydrogen bonds. The order of the base pairs in a strand is a code that stores information which is used to produce proteins.

Ribonucleic Acid (RNA):

RNA exists in the form of single strand. It is made of a ribose sugar, phosphate unit and nitrogen base. RNA is synthesized by DNA to transmit the genetic information. RNA is responsible for directing synthesis of new

3. Write differences between DNA and RNA.

Ans: i. DNA has the bases adenine, thymine, guanine, cytosine.
RNA has the bases adenine, uracil, guanine, cytosine.

ii. DNA has the sugar deoxyribose.
RNA has the sugar ribose.

iii. DNA is double stranded.
RNA is single stranded.

4. What is the sugar unit in DNA? **Ans:** Deoxyribose

5. What sugar is found in RNA? **Ans:** Ribose

6. Which nucleic acid is involved in protein synthesis? **Ans:** Ribonucleic acid (RNA)

Self-Assessment Exercise 13.6

1. Define vitamins.

Ans: Vitamins are specific organic compounds which are required by our bodies to prevent specific diseases but cannot be produced by our bodies.

2. Is vitamin C soluble in fat or in water? **Ans:** Vitamin C is soluble in water.

3. Give examples of fat soluble vitamins. **Ans:** Vitamin A, D, E and K.

Q1. Why are vitamins important for us?

Ans: Importance of vitamins:

Vitamins are substances that are essential for our bodies.

Vitamin A:

Vitamin A is important in vision. It helps in the chemical transmission of images from the eye to the brain. It also keeps the cornea moist.

Vitamin C:

Vitamin C is required for the formation of blood and boosting the immune system that protects against illnesses ranging from common cold to cancer.

Vitamin B:

Vitamin B helps to regulate nerve impulse transmissions, in the formation of haemoglobin and activates more than 100 different enzymes.

Vitamin D:

Vitamin D regulates blood calcium. It is necessary for proper bone and tooth growth.

Q2. Compare components in both proteins and carbohydrates?

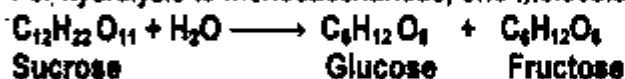
Ans: Proteins are the complex compounds made up of carbon, hydrogen, oxygen, nitrogen and sulphur.
Carbohydrates are the compounds made up of three elements carbon, hydrogen and oxygen.

Q3. What is the name of the bond that forms between two amino acids in building a protein?

Ans: Peptide bond.

Q4. How many molecules of water are needed to allow a disaccharide to form monosaccharides? Illustrate with a chemical equation.

Ans: For hydrolysis to monosaccharides, one molecule of a disaccharide needs only one molecule of water.

$$\underset{\text{Sucrose}}{C_{12}H_{22}O_{11}} + H_2O \longrightarrow \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Fructose}}{C_6H_{12}O_6}$$

Structurally, a disaccharide molecule may be viewed as a product formed by the condensation of two molecules of monosaccharides with the elimination of a water molecule. So, only one H_2O molecule is needed for the reverse process.

Q5. Distinguish between DNA and RNA?

Ans: There are two differences that distinguish DNA from RNA:

(a) RNA contains the sugar ribose, while DNA contains the slightly different sugar deoxyribose (a type of

GUESS PAPER & MODEL PAPER # 06
BASED ON CHAPTER # 14 (Reduced Syllabus)
ENVIRONMENTAL CHEMISTRY I: THE ATMOSPHERE

CHAPTER 14 : ENVIRONMENTAL CHEMISTRY I : ATMOSPHERE

Topics: Layers of atmosphere, Air pollutants, Effect and sources of air pollutant, Global warming, acid rain and its effects, Ozone depletion and its effect.

Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

i. Which gas has highest percentage in the air
A. O_2 B. CO_2 C. N_2 D. O_3

ii. Lowest temperature in stratosphere is
A. -5°C B. -55°C C. 5°C D. 55°C

iii. Which is/are responsible for acid rain?
A. SO_2 B. NO_2 C. Both NO_2 and SO_2 D. O_3

iv. Which is reddish brown gas?
A. NO B. NO_2 C. SO_2 D. O_3

v. Troposphere extends up to
A. 50 km B. 12 km C. 18 km D. 80 km

vi. Stratosphere extends up to
A. 12 km B. 15 km C. 50 km D. 80 km

vii. The ozone layer is found in
A. The troposphere B. The mesosphere
C. The thermosphere D. The stratosphere

viii. Most air pollution is caused by
A. Ozone B. Acid rain
C. Carbon monoxide D. The burning of fossil fuels

ix. Which layer is closest to the Earth?
A. The stratosphere B. The troposphere
C. The mesosphere D. The thermosphere

x. The outermost layer of earth atmosphere is
A. The mesosphere B. The stratosphere
C. The troposphere D. The thermosphere

xi. Acid rain is defined as rain having pH less than

CHEMISTRY SSC-II

Time allowed: 2:40 hours Total Marks: 53

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

i. List two main sources of acid rain.
ii. List four human activities which contribute to air pollution.
iii. What is the importance of stratospheric ozone?
iv. What is the role of automobile in air pollution?
v. Define atmosphere.
vi. List components of stratosphere and troposphere.
vii. Describe sources of air pollutants.
viii. Describe acid rain and its effects.

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

i. Describe ozone depletion and its effects.
ii. Describe global warming.
iii. Explain ozone formation.
iv. Why is global warming often referred to as the greenhouse effect?
v. There is scientific evidence that CFCs contribute to the depletion of ozone. Why?
vi. Explain temperature variation in mesosphere. List the components of mesosphere.
vii. Explain sources and effects of air pollutant sulphur oxides?

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q4. a. What do you understand by green house gases?
b. Certain human activity is threatening to cause a significant increase in the greenhouse effect. What are such activities?

Q5. a. Describe sources and harmful effects of air pollutants?
b. Explain temperature variation in thermosphere. List the components of thermosphere.

Q6. a. Which gas is emitted by volcanoes?
b. You might have noticed that the colour of silk clothes fades away, if left in open air for a week or so. What due to it is?
c. Draw flow diagram to represent air pollutants?

SOLUTION OF GUESS PAPER & MODEL PAPER # 6

(Reduced Syllabus)

SECTION- A (MCQs)

i. C	ii. B	iii. C	iv. B	v. B	vi. B
vii. D	viii. D	ix. B	x. B	xi. B	xii. A

SECTION – B (Marks 18)

Oxides of nitrogen and sulphur are released into the air when fossil fuels are burnt and when they mix with the precipitation in clouds acid rain is formed.

ii. List four human activities which contribute to air pollution.

Ans: i. Burning fossil fuel ii. Cutting trees
iii. Use of Freon gas iv. Production of methane from dead plant material decay.

iii. What is the importance of stratospheric ozone?

Ans: Importance of stratospheric ozone:

Ozone saves us from harmful effects of incoming ultraviolet radiations from the sun. When ozone absorbs energy from the sun, the energy is converted into heat, warming the air. The ozone layer protects the living things on the Earth from dangerous ultraviolet radiation from the sun.

iv. What is the role of automobile in air pollution?

Ans: Exhaust fumes of automobiles including dangerous gases such as carbon monoxide, oxides of nitrogen, hydrocarbons and particulates. These exhaust fumes of automobile are responsible for air pollution.

v. Define atmosphere.

Ans: Atmosphere:

The envelope of gases and water vapour surrounding the planet earth is called atmosphere.

vi. List components of stratosphere and troposphere.

Ans: Component of stratosphere:

This layer contains little water vapours. Interesting information about this layer is that it contains maximum amount of ozone (about 10ppm/parts per million). The presence of ozone is responsible for the rise in temperature in stratosphere.

Components of troposphere:

Nearly all the dust particles and water vapours are in the troposphere. Weather occurs in this layer. Most of the clouds are formed in the troposphere. Aircrafts fly in this region.

vii. Describe sources of air pollutants.

Ans: Sources of Air Pollution:

Air that contains harmful particles and gases is said to be polluted. Some air pollution occurs naturally. But many types of air pollution are the result of human activities.

i. Natural Sources:

Many natural processes such as forest fires and dust storms release smoke and dust particles into the air. Volcanoes emit clouds of dust and poisonous gases along with ash. Termites and cows also release large amount of methane in the air. Considerable electrical discharges in the atmosphere produce nitrogen oxides.

ii. Human Activities:

Most of the air pollution is the result of burning fossil fuels, such as coal, petroleum and natural gas. Nearly half of the air pollution comes from cars and other motor vehicles. Factories and power plants that burn coal or oil release poisonous gases in the air. Burning fossil fuels and incineration release carbon monoxide (CO), nitrogen oxides (NO, NO_2) and sulphur oxides (SO_2, SO_3).

$$C_{(s)} + O_{2(g)} \text{ (limited)} \longrightarrow CO_{(g)}$$
$$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$$
$$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$$
$$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$$

Chlorofluorocarbons:

Chlorofluorocarbons have been widely used as solvents for cleaning electronic circuit boards, as refrigerant in fridges and air-conditioning units and as propellants in aerosol sprays (air fresheners, hairsprays, deodorants, spray paints). Such products are not "Environment friendly". During manufacture, in use and after disposal, these compounds escape into the air.

Lead particles:

Lead particles in the air come mainly due to the combustion of leaded petrol or fuel used in motor

$$3O_{2\,(g)} \xrightarrow[\text{discharge}]{\text{Electrical}} 2O_{3\,(g)}$$

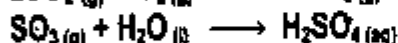
viii. Describe acid rain and its effects.

Ans: Acid Rain and Its Effects:

Acid rain is defined as rain having pH less than 5.6.

Normal rain water is saturated with carbon dioxide. It has pH of 5.6 However; the acidity of rain greatly increases in polluted areas during thunderstorm.

Sulphur dioxide from power plants using fossil fuels and nitrogen oxides from exhaust fumes of automobiles dissolve in rain water producing acids.

$$2SO_{2\,(g)} + O_{2\,(g)} \longrightarrow 2SO_{3\,(g)}$$
$$SO_{3\,(g)} + H_2O_{\,(l)} \longrightarrow H_2SO_{4\,(aq)}$$
$$2NO_{2\,(g)} + 3O_{2\,(g)} + 2H_2O_{\,(l)} \longrightarrow 4HNO_{3\,(aq)}$$

Therefore, during thunderstorm, the pH of rain water can be much lower because of sulphuric acid and nitric acids formed by lightening. This rain may have pH as low as 2.1. This value is lower than the pH of vinegar or lemon juice.

Effect of acid rain:

Acid rain may often fall hundreds of kilometer away from their sources. Acid rain corrodes metals, stone buildings and statues. Marble statues are slowly eroded by acid rain.

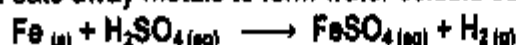
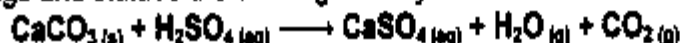
Sulphuric acid and metals:

Sulphuric acid eats away metals to form water soluble salts and hydrogen.

$$Fe_{\,(s)} + H_2SO_{4\,(aq)} \longrightarrow FeSO_{4\,(aq)} + H_{2\,(g)}$$

Marble buildings and statues:

Marble buildings and statues are disintegrated by acid rain

$$CaCO_{3\,(s)} + H_2SO_{4\,(aq)} \longrightarrow CaSO_{4\,(aq)} + H_2O_{\,(g)} + CO_{2\,(g)}$$
$$CaCO_{3\,(s)} + 2HNO_{3\,(aq)} \longrightarrow Ca(NO_3)_{2\,(aq)} + H_2O_{\,(g)} + CO_{2\,(g)}$$

Acid rain also kills fish, and destroys trees. Lakes and river may become too acidic for living things to survive. Trees destroyed by acid rain. Fish are killed by acid rain.

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. **(5 × 3 = 15)**

i. Describe ozone depletion and its effects.

Ans: Ozone Depletion and Its Effects:

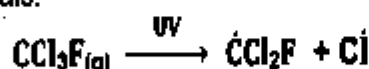
Human activity releases many compounds in the atmosphere. Such compounds threaten the stability of ozone layer. Over recent years, scientists have discovered a reduction in the amount of ozone in the stratosphere.

Ozone hole:

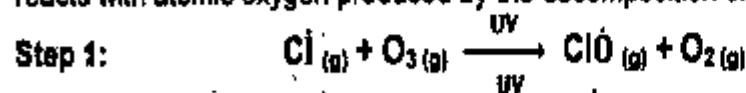
The region in which the amount of ozone has been reduced is called as ozone hole. Ozone hole was first observed in October, 1980 over Antarctica.

Chlorofluorocarbons:

Chlorofluorocarbons (from aerosol cans, air conditioning systems, refrigerators etc) escape into the atmosphere. CFCs are gases or low boiling liquids. They are so inert that they do not react with any other chemicals in the troposphere. They slowly diffuse into the ozone layer. UV radiation break CFCs molecule producing chlorine free radicals.

$$CCl_3F_{(g)} \xrightarrow{UV} \dot{C}Cl_2F + \dot{Cl}$$

Chlorine free radical reacts with ozone to form chlorine monoxide (ClO) and molecular oxygen. ClO reacts with atomic oxygen produced by the decomposition of ozone by UV radiations.

Step 1: $$\dot{Cl}_{\,(g)} + O_{3\,(g)} \xrightarrow{UV} Cl\dot{O}_{\,(g)} + O_{2\,(g)}$$

UV

The chlorine free radical that reacts in step 1 is regenerated in step 2. One Cl can, therefore, destroy thousands of ozone molecules.

ii. Describe global warming.

Ans: Global warming:

The warming of the atmosphere which is due to our influence on the greenhouse effect is known as global warming.

Global warming as a green house effect:

Global warming is due to an upset in the natural balance of the concentration of greenhouse gases in the atmosphere. If global warming continues, then

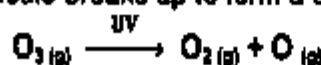
- Temperature of the earth will gradually increase.
- The earth climate may change, affecting both where there is rainfall and how much there is of it. This could cause both increased risks of flooding in some regions and drought in others.
- Polar ice may melt and cause significant increase in sea levels.
- So the atmosphere becomes hotter.

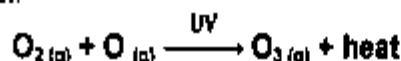
iii. Explain ozone formation.

Ans: Formation of ozone:

Ozone is an allotropic form of oxygen comprising there oxygen atoms, O_3 Ozone is an important gas in the stratosphere.

Most of the ultraviolet (UV) radiations coming from sun are filtered or screened out by the ozone layer. Otherwise, sunlight would be much more hazardous for human beings, animals and plants. On absorbing UV radiation, ozone molecule breaks up to form a oxygen molecule and atomic oxygen.

$$O_{3\,(g)} \xrightarrow{UV} O_{2\,(g)} + O_{(g)}$$

Atomic oxygen is very reactive. Atomic oxygen reacts readily with an oxygen molecule to form ozone, thereby releasing heat.

$$O_{2\,(g)} + O_{(g)} \xrightarrow{UV} O_{3\,(g)} + \text{heat}$$

These reactions maintain level of ozone in the stratosphere. Both the destruction and the reformation of ozone are powered by UV radiation. In the absence of outside intervention, the rates of ozone destruction and formation are equal. However, human activities disturb this natural balance.

iv. Why is global warming often referred to as the greenhouse effect?

Ans: The **enhanced greenhouse effect** (or accelerated greenhouse effect) is the warming effect caused by all the extra carbon dioxide greenhouse gas that man has put into the atmosphere in the past 100 years by burning fossil fuels (coal, oil and natural gas).

Global warming is the warming of the earth because of this enhanced greenhouse effect.

v. There is scientific evidence that CFCs contribute to the depletion of ozone. Why?

Ans: Ozone hole:

The region in which the amount of ozone has been reduced is called as ozone hole. Ozone hole was first observed in October, 1980 over Antarctica.

The CFCs are so stable that only exposure to strong UV radiation breaks them down. When that happens, the CFC molecule releases atomic chlorine. One chlorine atom can destroy over 100,000 ozone molecules.

vi. Explain temperature variation in mesosphere. List the components of mesosphere.

Ans: The Mesosphere:

The mesosphere extends from the top of stratosphere to about 80 km from the earth's surface. Meso- means "middle", so the mesosphere is the middle layer of the atmosphere. Above the stratosphere, a drop in temperature is observed. In the outer mesosphere, temperature approaches -93°C. This layer protects Earth's surface from being hit by most meteoroids.

vii. Explain sources and effects of air pollutant sulphur oxides?

Ans: Sulphur Oxides (SO_X):

In the air sulphur dioxide is converted into sulphur trioxide, which is responsible for acid rain.

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. **(2 × 10 = 20)**

Q4. a. What do you understand by green house gases?

Ans: Green house gases:

The increasing use of fossil fuels and the deforestation have led to an increase in the levels of CO_2 in the air. Gases like water vapour, methane and CFCs also act in a similar way in the atmosphere. These gases are called green house gases. Molecules of these gases absorb much of the infrared radiation given out by the surface of earth. This increases their kinetic energy. So the atmosphere becomes hotter.

The higher the concentration of green house gases in the air, the greater is the green house effect, and greater will be the increase in temperature. The green-house effect is a natural phenomenon of the energy distribution mechanism of the earth.

b. Certain human activity is threatening to cause a significant increase in the greenhouse effect. What are such activities?

Ans: Certain human activities add to the levels of most of these naturally occurring gases:

Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.

Methane emissions result from the rise production, the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock. Methane also is emitted during the production and transport of coal, natural gas, and oil:

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

Greenhouse gases that are not naturally occurring include by products of foam production, refrigeration, and air conditioning called **chlorofluorocarbons (CFCs)**, as well as **hydrofluorocarbons (HFCs)** and **perfluorocarbons (PFCs)** generated by industrial processes.

Q5. a. Describe sources and harmful effects of air pollutants?

Ans: Effect produced by air pollutants:

Air pollutant	Physical properties	Sources	Harmful effects
Carbon monoxide (CO)	Colourless, odourless and poisonous gas	Incomplete burning of wood, fuels and vehicle exhaust.	Headache, brain damage, death.
Sulphur dioxide (SO_2)	Colourless gas with unpleasant and irritating odour	Power stations and industries using fossil fuels	Breathing difficulties, bronchitis, emphysema, lung cancer, acid rain and green house effect
Oxides of nitrogen (NO, NO_2)	NO is colourless, odourless gas soluble in water. NO_2 is reddish brown gas with pungent odour soluble in water. Both are highly toxic gases	Exhaust fumes of motor vehicles, power stations and industries using fossil fuels	Coughs, headaches lung diseases, acid rain and greenhouse effect (global warming)
CFCs chlorofluorocarbons	Colourless gases	Aerosol sprays foams, refrigerants, air-conditioning systems.	Green house effect (Global warming), thinning of zone layer
Lead compounds	Poisonous solid particles	Exhaust fumes form motor vehicles	Brain damage, forest decline

b. Explain temperature variation in thermosphere. List the components of thermosphere.

Ans: Thermosphere:

The outermost layer of atmosphere is the thermosphere. It extends from 80 km above Earth's surface outward into space. Thermo- means heat. This layer is very hot up to 1800°C. This is because sunlight strikes the thermosphere first. Oxygen and nitrogen molecules convert this energy into heat.

Layers of thermosphere:

i. **Ionosphere:**
The lower layer called the ionosphere extends from 80 km to 400 km above the surface of Earth.

ii. **Exosphere:**
The outer layer of thermosphere is the exosphere. It extends from 400 km to thousands of kilometer from Earth's surface.

Q6. a. Which gas is emitted by volcanoes?

Ans: The largest portion of gases released into the atmosphere is water vapor. Other gases include carbon dioxide (CO_2), sulfur dioxide (SO_2), hydrochloric acid (HCl), hydrogen fluoride (HF), hydrogen sulfide (H_2S), carbon monoxide (CO), hydrogen gas (H_2), NH_3, methane (CH_4), and SiF_4.

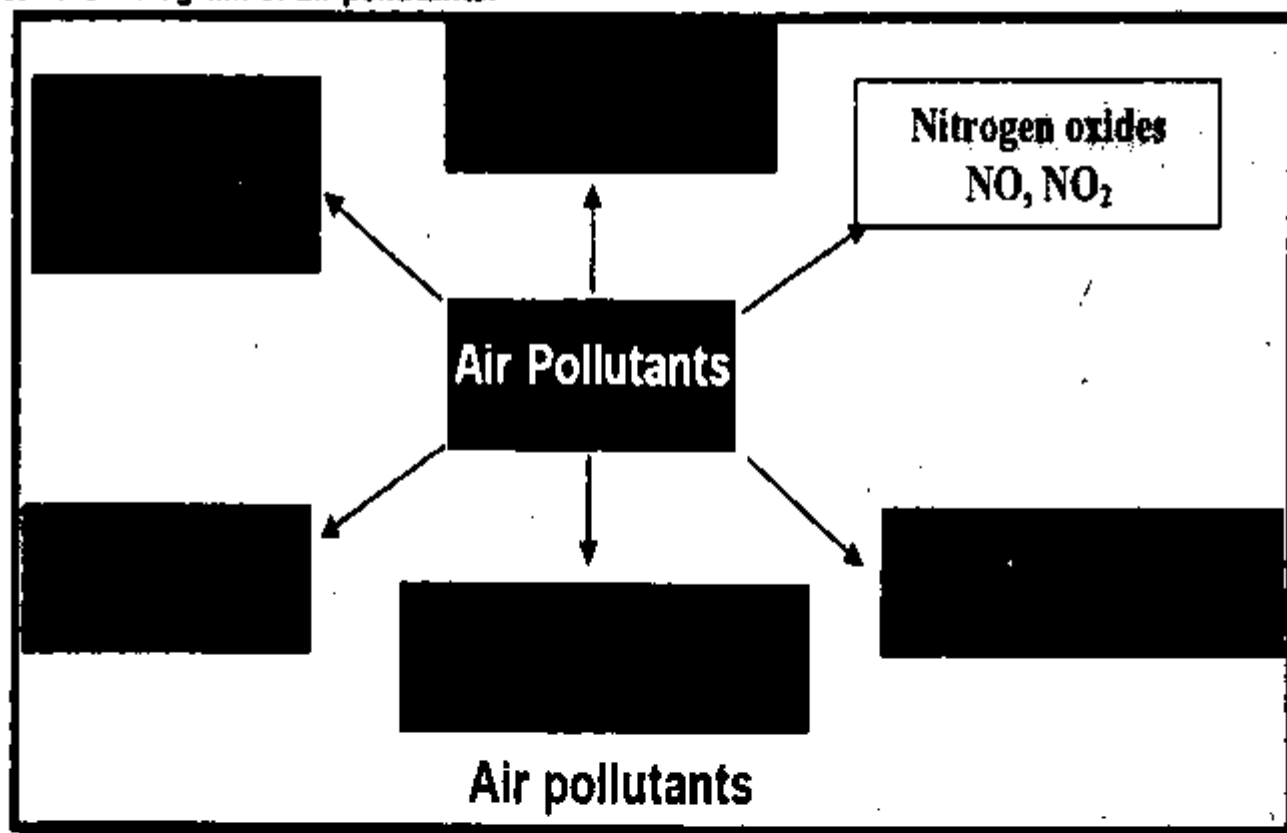
b. You might have noticed that the colour of silk clothes fades away, if left in open air for a week or so. What due to it is?

Ans: Photodegradation:
The technical term for color fading is photodegradation. There are light absorbing color bodies called chromophores that are present in dyes. The color(s) we see are based upon these chemical bonds and the amount of light that is absorbed in a particular wavelength.

Ultraviolet rays can break down the chemical bonds and thus fade the color(s) in an object. It is a bleaching effect.

c. Draw flow diagram to represent air pollutants?

Ans: Flow diagram of air pollutants:

Air pollutants

Important Questions & Answers (Reduced Syllabus)

Q1. List the layers of atmosphere?

Ans: Layers of Atmosphere:
The atmosphere is divided into four layers:

i. The troposphere ii. The stratosphere

Self-Assessment Exercise 14.2

- **Describe how temperature changes as one moves from Earth's surface into the atmosphere up to 50 km?**

Solution: 1 km increase in altitude = 6.5 °C cooler
50 km increase in altitude = 6.5 °C × 50 = 325 °C cooler

Self-Assessment Exercise 14.3

1. **What are pollutants?**

Ans: Anything that is in the air, water or soil which has a harmful effect on some part of the environment is called pollutant.

2. **List some effects of sulphur dioxide on human beings.**

Ans: Sulphur dioxide is readily absorbed in the respiratory system. Being powerful irritant, it aggravates the symptoms of people who suffer from asthma, bronchitis, emphysema and other lung diseases.

3. **List some of the air pollutants.**

Ans: Important air pollutants are as follows:

i. Sulphur Oxides (SO_x) ii. Carbon Monoxide
iii. Nitrogen Oxides (NO_x) iv. Methane
v. Chlorofluorocarbons (CFCs) vi. Lead Compounds
vii. Ozone

Self-Assessment Exercise 14.4

1. **Write the names of main pollutants in the air.**

Ans: Important air pollutants are as follows:

i. Sulphur Oxides (SO_x) ii. Carbon Monoxide
iii. Nitrogen Oxides (NO_x) iv. Methane
v. Chlorofluorocarbons (CFCs) vi. Lead Compounds
vii. Ozone

2. **Complete the following reactions.**

a) $SO_{2(g)} + O_{2(g)} \longrightarrow$ **Ans:** $2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_3$
b) $C_{(s)} + O_{2(g)} \longrightarrow$ **Ans:** $2C_{(s)} + O_{2(g)} \longrightarrow 2CO$
c) $CO_{(g)} + O_{2(g)} \longrightarrow$ **Ans:** $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_2$

Self-Assessment Exercise 14.5

1. **Write three human activities that are responsible for air pollution.**
Human activities that damage the environment:

Ans: i. Burning fossil fuel ii. Cutting trees iii. Use of Freon gas

2. **Write three natural processes that are contributing in air pollution.**

Ans: Natural Sources:

Many natural processes such as forest fires and dust storms release smoke and dust particles into the air. Volcanoes emit clouds of dust and poisonous gases along with ash. Termites and cows also release large amount of methane in the air. Considerable electrical discharges in the atmosphere produce nitrogen oxides.

3. **List main sources of the following air pollutants.**

Self-Assessment Exercise 14.6

1. Define global warming:

Ans: The warming of the atmosphere which is due to our influence on the greenhouse effect is known as global warming.

2. List some effects of global warming

Ans: Effects of global warming:

Global warming is due to an upset in the natural balance of the concentration of greenhouse gases in the atmosphere. If global warming continues, then

- Temperature of the earth will gradually increase.
- The earth climate may change, affecting both where there is rainfall and how much there is of it. This could cause both increased risks of flooding in some regions and drought in others.
- Polar ice may melt and cause significant increase in sea levels.
- So the atmosphere becomes hotter.

3. List some substances that are responsible for global warming.

Ans: The main causes of global warming, in order of the magnitude of their impact, are:

1. **Carbon Dioxide from:** **i.** Fossil Fuel **ii.** Deforestation
2. **Methane from:** Cattle and Rice Paddies
3. **Nitrogen Oxides** from Farming
   Nitrogen oxides have 300 times more heat-trapping capacity per unit of volume than does carbon dioxide, and we release them every time we apply fertilizer to soil.
4. **CFCs** and **HCFCs** (chlorofluorocarbons and hydrochlorofluorocarbons) used in refrigeration are also powerful greenhouse gases. These gases occur in lower concentrations in the atmosphere, but because they are so much more potent than carbon dioxide in some cases hundreds of times more potent per unit of volume they contribute to global warming as well.

Self-Assessment Exercise 14.7

1. Define acid rain.

Ans: Acid rain is defined as rain having pH less than 5.6.

2. Write names of gases that cause acid rain.

Ans: SO_2 and NO_2

3. What is the effect of acid rain on iron and marble? Give balanced chemical equation.

Ans: Sulphuric acid and metals:

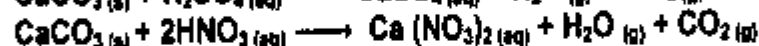
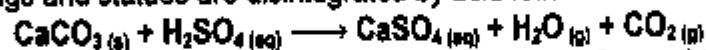
Sulphuric acid eats away metals to form water soluble salts and hydrogen

$$Fe_{(s)} + H_2SO_{4(aq)} \longrightarrow FeSO_{4(aq)} + H_{2(g)}$$

Marble buildings and statues:

Marble buildings and statues are disintegrated by acid rain

$$CaCO_{3(s)} + H_2SO_{4(aq)} \longrightarrow CaSO_{4(aq)} + H_2O_{(l)} + CO_{2(g)}$$

$$CaCO_{3(s)} + 2HNO_{3(aq)} \longrightarrow Ca(NO_3)_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$$

4. List some effects caused by acid rain.

Ans: Acid rain corrodes metals, stone buildings and statues. Marble statues are slowly eroded by acid rain.

Q3. Explain temperature variation in stratosphere and troposphere.

Ans: Temperature variation in stratosphere:

In the stratosphere, temperature varies from -55°C to -5°C

Temperature variation in troposphere:

As altitude increases in the troposphere, the temperature decreases from 17°C to about -55°C. On average, for every 1 km increase in altitude, the air gets about 6.5°C cooler.

Q4. Differentiate between stratosphere and troposphere.

Ans: Location:

Between the troposphere and stratosphere is a small layer of the atmosphere called tropopause. The stratosphere is about 50 kilometers from the surface of the earth.

Temperatures:

The temperatures in the troposphere decrease by 6.5 degrees Celsius for every kilometer away from the earth's surface. The temperature stabilizes at around 12 kilometers.

The stratosphere's temperature is about -50 degrees Celsius where it is closest to the earth. The upper layers are actually warmer and average -18 degrees Celsius. The reason for the warming, as this layer gets farther from the earth, is the presence of Ozone. Ozone absorbs sunlight and reflects it away from the earth.

Q5. Describe sources of air pollutants.

Ans: Sources of Air Pollution:

i. Natural Sources:

Many natural processes such as forest fires and dust storms release smoke and dust particles into the air. Volcanoes emit clouds of dust and poisonous gases along with ash. Termites and cows also release large amount of methane in the air. Considerable electrical discharges in the atmosphere produce nitrogen oxides.

ii. Human Activities:

Most of the air pollution is the result of burning fossil fuels, such as coal, petroleum and natural gas. Nearly half of the air pollution comes from cars and other motor vehicles. Factories and power plants that burn coal or oil release poisonous gases in the air. Burning fossil fuels and incineration release carbon monoxide (CO), nitrogen oxides (NO, NO_2) and sulphur oxides (SO_2, SO_3).

$$C_{(s)} + O_{2(g)} \text{ (limited)} \longrightarrow CO_{(g)}$$
$$S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$$
$$N_{2(g)} + O_{2(g)} \longrightarrow 2NO_{(g)}$$
$$2NO_{(g)} + O_{2(g)} \longrightarrow 2NO_{2(g)}$$

Chlorofluorocarbons:

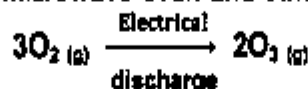
Chlorofluorocarbons have been widely used as solvents for cleaning electronic circuit boards, as refrigerant in fridges and air-conditioning units and as propellants in aerosol sprays (air fresheners, hairsprays, deodorants, spray paints). Such products are not "Environment friendly". During manufacture, in use and after disposal, these compounds escape into the air.

Lead particles:

Lead particles in the air come mainly due to the combustion of leaded petrol or fuel used in motor vehicles or from lead based paints.

Ozone:

Ozone is produced when electrical discharges pass through oxygen in the air. You can feel its presence near photocopier, television set, microwave oven and other electrical equipment.

$$3O_{2(g)} \xrightarrow[\text{discharge}]{\text{Electrical}} 2O_{3(g)}$$

Q6. Sulphur dioxide is a common pollutant from burning coal. State two effects caused by this pollutant.

Ans: Sulphur Oxides (SO_X):

In the air sulphur dioxide is converted into sulphur trioxide, which is responsible for acid rain.

$$2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$$

Sulphur dioxide is readily absorbed in the respiratory system. Being powerful irritant, it aggravates the symptoms of people who suffer from asthma, bronchitis, emphysema and other lung diseases.

Q7. Dibenzothiophene ($C_{12}H_8S$) is a common sulphur containing compound of coal. It is responsible for acid rain. Elaborate this statement.

Ans: Dibenzothiophene ($C_{12}H_8S$) is a sulphur containing compound of coal on burning it produces sulphur dioxide. In the air sulphur dioxide is converted into sulphur trioxide, which is responsible for acid rain.

Q8. There have been various attempts to remove sulphur from coal before it is burned. Illustrate.

Q9. Examine the option there are some ways to reduce pollution caused by cars?

Ans: Catalytic converter:

A catalytic converter transforms **CO** into CO_2, NO into N_2 and O_2, and unburned hydrocarbons to CO_2 and H_2O. Metals like platinum, palladium and rhodium are used as catalyst in the converter. Government of Pakistan should direct car manufacturers to install catalytic converters in car exhaust system. Government should make strict laws in this regards.

Similar to scrubbers on power plants, catalytic converters reduce NO_x emissions from cars.

Q10. Certain human activities are responsible for a significant increase in green house effect, argue.

Ans: Primarily by two actions: **Burning fossil fuels**, with a smaller contribution from **clear cutting forests**, known as deforestation.

Greenhouse gases trap heat:

When we extract and burn fossil fuels such as coal or petroleum, we cause the release of carbon dioxide carbon dioxide and other heat-trapping "greenhouse gases" into the atmosphere.

Losing forests makes it worse:

Clearing forests also releases large amounts of carbon dioxide. On top of that, plants and trees use it to grow. Worldwide deforestation means we don't have as many trees to absorb the extra carbon dioxide.
This means more of carbon dioxide stays in the atmosphere, trapping more heat.

So what do we do about it?

To make real progress at the global level we need to **convince leaders** to create laws that improve our energy policy, and **push companies** to adopt sustainable business practices.

Q11. Compare and contrast between stratosphere and troposphere.

Ans: Comparison between stratosphere and troposphere:

i. Stratosphere:

The second layer as one moves upward from the Earth's surface is called stratosphere. The stratosphere extends from top of the troposphere to about 50km above earth's surface. Strato- means "layer", or "spread out". The lower stratosphere is cold about -55°C, but the upper stratosphere is warmer than the lower stratosphere.

Component of stratosphere:

This layer contains little water vapours. Interesting information about this layer is that it contains maximum amount of ozone (about 10 ppm/parts per million). The presence of ozone is responsible for the rise in temperature in stratosphere.

Function of ozone:

Ozone saves us from harmful effects of incoming ultraviolet radiations from the sun. When ozone absorbs energy from the sun, the energy is converted into heat, warming the air. The ozone layer protects the living things on the Earth from dangerous ultraviolet radiation from the sun.

Temperature variation in stratosphere:

In the stratosphere, temperature varies from -55°C to -5°C

ii. Troposphere:

Tropo- means "turning" or "changing". Conditions in troposphere are more variable than in the other layers. Troposphere extends to about 12km above earth's surface. The atmospheric layer closest to the Earth's surface is called troposphere.

Troposphere contains most of the mass (75-80%) of the atmosphere. It is the layer of atmosphere in which we live.

Components of troposphere:

Nearly all the dust particles and water vapours are in the troposphere. Weather occurs in this layer. Most of the clouds are formed in the troposphere. Aircrafts fly in this region.

Temperature variation in troposphere:

GUESS PAPER & MODEL PAPER # 07
BASED ON CHAPTER # 15 (Reduced Syllabus)
ENVIRONMENTAL CHEMISTRY II: WATER

CHAPTER 15 : ENVIRONMENTAL CHEMISTRY II : WATER

Topics: Soft and Hard water, Types of soft and hard water, Methods of removing hardness of water, Water borne Diseases.

Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

i. Permanent hardness of water is caused due to the presence of dissolved
A. calcium hydrogen carbonates B. magnesium hydrogen carbonates
C. chlorides of magnesium D. Sulphates of magnesium

ii. Which of the following is an intestinal disease caused by bacteria such as E.coli?
A. cholera B. dysentery C. jaundice D. hepatitis

iii. Which salt does not cause the water to become hard?
A. calcium hydrogen carbonate B. magnesium hydrogen carbonate
C. magnesium sulphate. D. Sodium chloride.

iv.. Which salt causes temporary hardness in water?
A. magnesium sulphate B. calcium sulphate
C. both calcium sulphate and magnesium sulphate D. magnesium hydrogen carbonate

v. Heating calcium hydrogen carbonate produces____________.
A. CO_2 B. H_2O C. $CaCO_3$ D. all of these

vi. Which of the followings is not a water born disease?
A. hepatitis B. typhoid C. dysentery D. anemia

vii. Which human activity results in contamination of water bodies?
A. livestock waste B. pesticides C. septic tanks D. all of these

viii. Which is used to remove permanent hardness in water?
A. slaked lime B. washing soda C. boiling water D. all of these

ix. The fresh water available to man is only ______ of the total.
A. 0.2% B. 0.3% C. 0.4% D. 0.5%

x. formula of washing soda is ____________.
A. $(NaCO_3.10H_2O)$ B. $(Na_2CO_3.10H_2O)$

xii. Total amount of water present on earth is about ________ billion cubic kilometers.
A. 1.33 B. 1.32 C. 1.31 D. 1.45

CHEMISTRY SSC-II

Time allowed: 2:40 hours — Total Marks: 53

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)
i. List the impurities present in rain water.
ii. What is water pollution?
iii. List some waterborne diseases.
iv. What are pathogenic microorganisms?
v. What is hard water? Why is it sometimes undesirable?
vi. Give chemical equations for the
  a) reaction of slaked lime with alum.
  b) carbonated rain water with lime stone.
  c) reaction that occurs when temporary hard water is boiled.
  d) Ca^{+2} ions interact with sodiumzeolite.
vii. How does hard water differ from soft water?
viii. What is the purpose of coagulation in water treatment?

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)
i. What are some health effects of biological contamination of water?
ii. Water born diseases are no longer common in developed countries. Defend this statement.
iii. How chemistry helps maintain a clean swimming pool? Explain.
iv. Which water is soft, tap water or distilled water?
v. Have you ever noticed that the pan which is regularly used for boiling water gets white or yellowish deposits at its bottom and sides?
vi. Differentiate among temporary and permanent hard water.
vii. List two cations and three anions present in lake or surface water.

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)
Q4. a. Describe the various types of waterborne diseases.
  b. Explain how hard water hampers the cleansing action of soap.
Q5. a. How does hardness produced in water?
  b. Describe the methods to remove permanent hardness of water?
Q6. Describe the methods to remove temporary hardness of water?

SOLUTION OF GUESS PAPER & MODEL PAPER # 7
(Reduced Syllabus)

SECTION- A (MCQs)

CHEMISTRY SSC-II

Time allowed: 2:40 hours **Total Marks: 53**

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

i. List the impurities present in rain water.

Ans: Rainwater contains pollutants, soil, plant parts, insect parts, bacteria, algae, and sometimes radioactive materials that the rain/snow has washed out of the air.

The collected rain water requires treatment even though rain water is not in itself contaminated but as there are many pollutants and impurities present in the atmosphere, such as suspended particulate matter, harmful gases like oxides of nitrogen and sulphur, etc which either react with the rain water or get dissolved in it; therefore treatment of the rain water becomes important.

ii. What is water pollution?

Ans: Water Pollution:

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds.

iii. List some waterborne diseases.

Ans: **i.** Cholera **ii.** Dysentery **iii.** Jaundice **iv.** Hepatitis **v.** Typhoid

iv. What are pathogenic microorganisms?

Ans: An organism of microscopic size, usually a bacteria or virus, that causes disease.

v. What is hard water? Why is it sometimes undesirable?

Ans: Hard water: Water that gives little lather or forms scum with soap is called hard water.

Hard water is undesirable:

"Hard" water- water with a lot of dissolved minerals- usually calcium, does not work with soaps or detergents. It is hard to "lather" with hard water, and you use more cleaning product to get the same effect. Second, the minerals can be deposited in pipes, fixtures and appliances, clogging or wearing them prematurely.

vi. Give chemical equations for the

a) reaction of slaked lime with alum.

b) carbonated rain water with lime stone.

c) reaction that occurs when temporary hard water is boiled.

d) Ca^{+2} ions interact with sodiumzeolite.

Solution:

a) reaction of slaked lime with alum.

$$3Ca(OH)_{2\,(aq)} + Al_2(SO_4)_{3\,(aq)} \longrightarrow 2Al(OH)_{3\,(s)} + 3CaSO_{4\,(aq)}$$

b) carbonated rain water with lime stone.

$$CaCO_{3(s)} + H_2CO_{3\,(aq)} \longrightarrow Ca(HCO_3)_{2\,(aq)}$$

c) reaction that occurs when temporary hard water is boiled.

$$Ca(HCO_3)_{2\,(aq)} \longrightarrow 2CaCO_{3\,(s)} + CO_{2\,(g)} + 2H_2O_{(l)}$$

$$Mg(HCO_3)_{2\,(aq)} \longrightarrow 2MgCO_{3\,(s)} + CO_{2\,(g)} + 2H_2O_{(l)}$$

d) Ca^{+2} ions interact with sodiumzeolite.

$$Ca^{+2}_{(aq)} + Na_2Z \longrightarrow 2Na^{+}_{(aq)} + CaZ_{(s)}$$

vii. How does hard water differ from soft water?

Ans: Soft water: Water that easily gives lather with soap and does not form scum is called soft water.

viii. What is the purpose of coagulation in water treatment?

Ans: Coagulation: It is the process in which water is treated with slaked lime and alum. These materials react to form a gelatinous mass of aluminum hydroxide.

$$3Ca(OH)_{2\,(aq)} + Al_2(SO_4)_{3\,(aq)} \longrightarrow 2Al(OH)_{3\,(s)} + 3CaSO_{4\,(aq)}$$

The aluminum hydroxide carries down dirt particles and bacteria.

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

i. What are some health effects of biological contamination of water?

Ans: Bacterial contents may cause infectious diseases such as cholera, jaundice, hepatitis, typhoid, dysentery etc.

Cause	Water-borne diseases
Bacterial infections	Typhoid, Cholera, Paratyphoid fever, Bacillary dysentery
Viral infections	Infectious Hepatitis (jaundice), Poliomyelitis
Protozoal infections	Amoebic dysentery

ii. Water born diseases are no longer common in developed countries. Defend this statement.

Ans: Most waterborne diseases occur worldwide. In developed (western) countries, contagion (infections) is prevented by drinking water purification and by hygienic measurements.

But even in developed countries, people can fall ill from waterborne diseases. This is caused by using insufficiently disinfected water, by implementing non-hygienic food preparation and by insufficient personal hygiene.

iii. How chemistry helps maintain a clean swimming pool? Explain.

Ans: Water in swimming pools is purified from pathogenic organisms by aeration and chlorination. Chlorination is probably the best and the cheapest method of sterilization of water and it is the most effective in destroying pathogenic bacteria. For chlorination, liquid chlorine may be added directly in the swimming pool water.

iv. Which water is soft, tap water or distilled water?

Ans: Tap water contains impurities (**$CaSO_4$, $MgSO_4$**) in the water that distilled water does not have. Therefore distilled water is a soft water.

v. Have you ever noticed that the pan which is regularly used for boiling water gets white or yellowish deposits at its bottom and sides?

Ans: This is due to the boiler scales of **$CaCO_3$** and **$MgCO_3$**.

vi. Differentiate among temporary and permanent hard water.

OR Describe the types of hardness of water?

Ans: Types of hardness of water.

Hardness in water can be divided into two types, **temporary** and **permanent**.

Temporary hardness: Temporary hardness is so called because it can be removed by boiling.

Permanent hardness:

Permanent hardness is so called because it cannot be removed by boiling Temporary hardness is caused by the presence of dissolved calcium or magnesium hydrogen carbonates. Whereas permanent hardness in caused by the presence of dissolved sulphates and chlorides of calcium or magnesium.

Hard water hampers cleaning action of soap.

vii. List two cations and three anions present in lake or surface water.

Ans: Cations (Ca^{+2}, Mg^{+2}, Na^{+1}, and K^{+1}). **Anions (SO_4^{-2}, Cl^{-1}, and NO_3^{-1}).**

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q4. a. Describe the various types of waterborne diseases.

Ans: Waterborne Disease:

i. Cholera:

Cholera is an intestinal disease. It is caused by bacteria such as vibrio cholerae, E.coli etc. which may be present in water contaminated with human wastes. It is characterized by vomiting and purging.

ii. Dysentery:

Dysentery is also an intestinal disease. It is caused by parasite, Entamoeba. This infection is transmitted by faecal contamination of water or food by encysted organism. Patients have mild to severe abdominal cramps, diarrhea, chocolate coloured stool with mucous and sometimes with blood.

iii. Jaundice:

This disease proceeds from obstruction of liver. Excess of bile from the liver enters in the blood and causes yellowness of skin and eyes. It leads to loss of appetite, weakness and fatigue.

iv. Hepatitis:

Hepatitis is acute inflammation of liver. It is caused by viruses, and classified as Hepatitis A, B, C, D and E. Hepatitis A and E spreads through polluted water.

v. Typhoid:

Typhoid is a dangerous intestinal disease. It spreads by polluted water containing bacteria such as salmonella typhi, salmonella paratyphi, and salmonella enteritidis. It is characterized by continuous fever between **101°F to 104°F** and irregular pulse.

b. Explain how hard water hampers the cleansing action of soap.

Ans: Effect of Hard Water:

Unfortunately, hardness minerals (calcium or magnesium ions) combine with soap to form an insoluble "curd," which can remain as a residue on washed laundry.

This is similar to the difficult-to-clean residue found on bathroom tubs, sinks, and tile in hard water areas. Hardness also tends to counteract soap's alkalinity, which reduces its cleaning ability and requires the use of greater quantities to get laundry clean.

Q5. a. How does hardness produced in water?

Ans: Causes of hardness in water:

Rainwater dissolves carbon dioxide as it falls through the atmosphere. Carbon dioxide reacts with water to produce carbonic acid, which is a weak acid.

$$CO_{2(g)} + H_2O_{(l)} \rightleftharpoons H_2CO_{3(aq)}$$

This carbonated water passes over or through the rocks containing calcium carbonate or magnesium carbonate, the acid present in it attacks these rocks. It slowly dissolves them, forming calcium and magnesium hydrogen carbonates.

$$CaCO_{3(s)} + H_2CO_{3(aq)} \longrightarrow Ca(HCO_3)_{2(aq)}$$

$$MgCO_{3(s)} + H_2CO_{3(aq)} \longrightarrow Mg(HCO_3)_{2(aq)}$$

Some rocks may contain gypsum (**$CaSO_4.2H_2O$**) or anhydride (**$CaSO_4$**) or Kieserite (**$MgSO_4H_2O$**) which is sparingly soluble in water. The presence of these dissolved salts causes the water to become hard.

b. Describe the methods to remove permanent hardness of water?

Ans: Methods to remove permanent hardness:

i) By adding washing soda:

On the large scale permanent hardness in water can be removed by adding washing soda (**$Na_2CO_3.10H_2O$**). **Ca^{+2}** and **Mg^{+2}** ions are removed as their insoluble carbonates.

$$M^{+2}_{(aq)} + CO_{3(aq)}^{-2} \longrightarrow MCO_{3(s)}$$

Where $M = Ca^{+2}, Mg^{+2}$

ii) By Ion Exchange Resins:

The hard water is passed through a container filled with a suitable resin containing sodium ions. Zeolite is one of the natural ion exchanger. Chemically it is sodium aluminum silicate. It is usually written as **Na_2Z**. The **Ca^{+2}** or **Mg^{+2}** ions causing the hardness are exchanged with Na^+ ions in the resin.

$$M^{+2}_{(aq)} + Na_2Z_{(s)} \longrightarrow 2Na^+_{(aq)} + MZ_{(s)}$$

Where $M^{+2} = Ca^{+2}, Mg^{+2}$

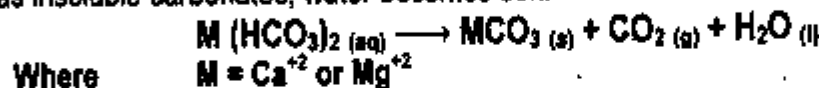
Q6. Describe the methods to remove temporary hardness of water?

Ans: Methods to remove temporary hardness:

i) By Boiling:

Hardness of water can be removed simply by boiling. During boiling the soluble calcium and magnesium hydrogen carbonates are decomposed forming insoluble carbonates. Since Ca^{+2} and Mg^{+2} ions are removed as insoluble carbonates, water becomes soft.

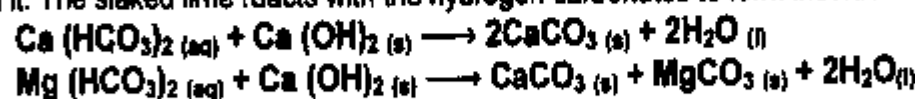
$$M(HCO_3)_{2\,(aq)} \longrightarrow MCO_{3\,(s)} + CO_{2\,(g)} + H_2O_{(l)}$$

Where $M = Ca^{+2}$ or Mg^{+2}

Unfortunately, this method is too expensive to remove temporary hardness of water on the large scale.

ii) By adding slaked lime (Clark's method):

Temporary hardness in water on the large scale can be removed by adding an estimated amount of slaked lime in it. The slaked lime reacts with the hydrogen carbonates to form insoluble carbonates.

$$Ca(HCO_3)_{2\,(aq)} + Ca(OH)_{2\,(s)} \longrightarrow 2CaCO_{3\,(s)} + 2H_2O_{(l)}$$

$$Mg(HCO_3)_{2\,(aq)} + Ca(OH)_{2\,(s)} \longrightarrow CaCO_{3\,(s)} + MgCO_{3\,(s)} + 2H_2O_{(l)}$$

Important Questions & Answers (Reduced Syllabus)

Self-Assessment Exercise 15.2

1. **List substances that cause hardness in water.**
2. **Differentiate between soft and hard water.**

Solution:

1. **List substances that cause hardness in water:**

Carbonate hardness compounds (Temporary Hardness)	Noncarbonated hardness compounds (Permanent Hardness)
Calcium carbonate ($CaCO_3$)	Calcium sulfate ($CaSO_4$)
Magnesium carbonate ($MgCO_3$)	Magnesium sulfate ($MgSO_4$)
Calcium bicarbonate ($Ca(HCO_3)_2$)	Calcium chloride ($CaCl_2$)
Magnesium bicarbonate ($Mg(HCO_3)_2$)	Magnesium chloride ($MgCl_2$)
Calcium hydroxide ($Ca(OH)_2$)	
Magnesium hydroxide ($Mg(OH)_2$)	

Carbonate hardness is sometimes called **temporary hardness** because it can be removed by boiling water. Noncarbonated hardness cannot be broken down by boiling the water, so it is also known as **permanent hardness**.

2. **Differentiate between soft and hard water:**

The presence of calcium and magnesium salts in the form of hydrogencarbonate, chloride and sulphate in water makes water 'hard'. Hard water does not give lather with soap.

Whereas, water free from souluble salts of calcium and magnesium is called soft water. It gives lather with soap.

Hard water forms scum (precipitate) with soap, therefore unsuitable for laundry but soft water does not form scum.

Self-Assessment Exercise 15.3

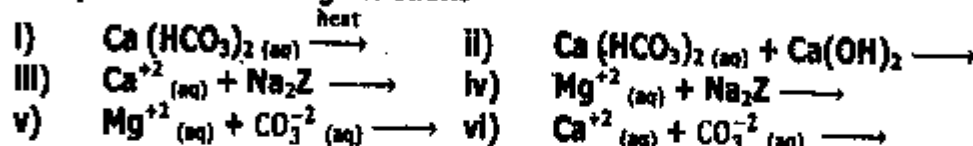
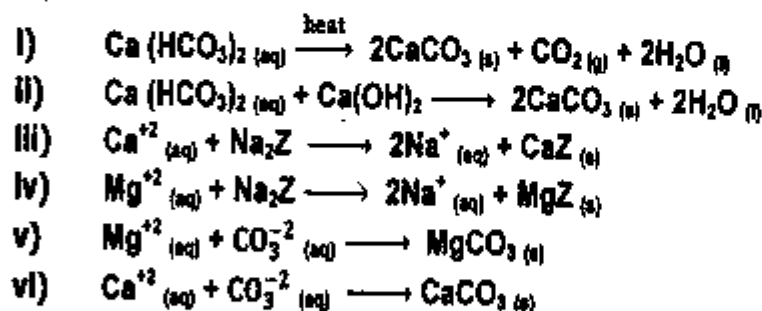
- **Write chemical equations to show the changes that occur when hard water containing**

Self-Assessment Exercise 15.4

- **Complete the following reactions**

i) $Ca(HCO_3)_{2(aq)} \xrightarrow{heat}$ ii) $Ca(HCO_3)_{2(aq)} + Ca(OH)_2 \longrightarrow$
iii) $Ca^{+2}_{(aq)} + Na_2Z \longrightarrow$ iv) $Mg^{+2}_{(aq)} + Na_2Z \longrightarrow$
v) $Mg^{+2}_{(aq)} + CO_3^{-2}{}_{(aq)} \longrightarrow$ vi) $Ca^{+2}_{(aq)} + CO_3^{-2}{}_{(aq)} \longrightarrow$

Solution:

i) $Ca(HCO_3)_{2(aq)} \xrightarrow{heat} 2CaCO_{3(s)} + CO_{2(g)} + 2H_2O_{(l)}$
ii) $Ca(HCO_3)_{2(aq)} + Ca(OH)_2 \longrightarrow 2CaCO_{3(s)} + 2H_2O_{(l)}$
iii) $Ca^{+2}_{(aq)} + Na_2Z \longrightarrow 2Na^+_{(aq)} + CaZ_{(s)}$
iv) $Mg^{+2}_{(aq)} + Na_2Z \longrightarrow 2Na^+_{(aq)} + MgZ_{(s)}$
v) $Mg^{+2}_{(aq)} + CO_3^{-2}{}_{(aq)} \longrightarrow MgCO_{3(s)}$
vi) $Ca^{+2}_{(aq)} + CO_3^{-2}{}_{(aq)} \longrightarrow CaCO_{3(s)}$

Self-Assessment Exercise 15.6

1. **Write effects produced by industrial wastes.**

Ans: Industrial Wastes:

Industrial wastes may contain highly toxic compounds and heavy metals such as **Pd, Cd, Cr, Hg, As, Sb** etc. These toxic substances cause serious health problems, such as nervous disorder, anemia, high blood pressure, kidney diseases, nausea, dizziness and cancer.

Water from leather tanneries contains large quantities of chromium (VI) salts. Chromium (VI) ions are highly toxic and known to cause cancer.

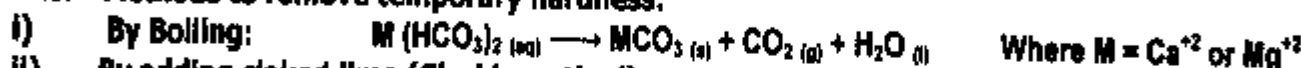
Industrial wastes cause irreversible degeneration of the environment causing serious health problems for public and marine life.

2. **Write names of six household wastes.**

Ans: Household Wastes:

Household wastes include, human wastes, livestock wastes, soaps and detergents, paints and oil, food and vegetable wastes, garbage etc.

Q1. Make a list of main methods of softening hard water. In each case write a chemical equation to summarize the chemical reactions involved.

Ans: Methods to remove temporary hardness:

i) **By Boiling:** $M(HCO_3)_{2(aq)} \longrightarrow MCO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$ **Where M = Ca^{+2} or Mg^{+2}**

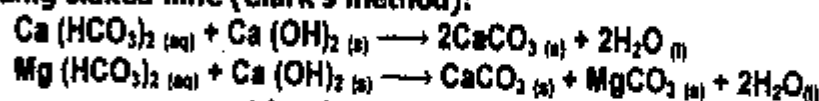
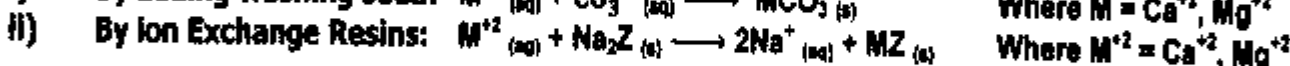
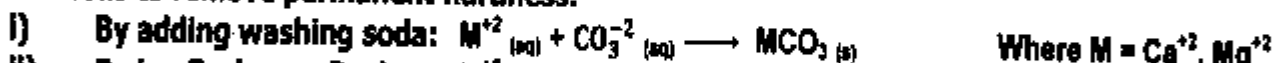
ii) **By adding slaked lime (Clark's method):**

$Ca(HCO_3)_{2(aq)} + Ca(OH)_{2(s)} \longrightarrow 2CaCO_{3(s)} + 2H_2O_{(l)}$

$Mg(HCO_3)_{2(aq)} + Ca(OH)_{2(s)} \longrightarrow CaCO_{3(s)} + MgCO_{3(s)} + 2H_2O_{(l)}$

Methods to remove permanent hardness:

i) **By adding washing soda:** $M^{+2}_{(aq)} + CO_3^{-2}{}_{(aq)} \longrightarrow MCO_{3(s)}$ **Where M = Ca^{+2}, Mg^{+2}**

ii) **By Ion Exchange Resins:** $M^{+2}_{(aq)} + Na_2Z_{(s)} \longrightarrow 2Na^+_{(aq)} + MZ_{(s)}$ **Where M^{+2} = Ca^{+2}, Mg^{+2}**

Q2. Why is it cooler near a lake than inland during summer?

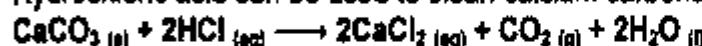
Ans: Since rate of evaporation increases with the increase in temperature during summer. Since evaporation cause cooling therefore it is cooler near a lake than inland during summer.

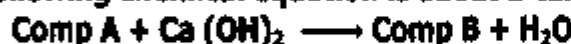
(Rate of evaporation $\propto$ temperature)

Q3. Evaluate the cation, ion exchange resins ...

The principle of this method is that, the ions, i.e. Ca^{2+}, Mg^{2+} or Fe^{2+}, which cause hardness are removed from water by exchanging them with other cations from the ion exchangers which do not cause hardness - by this, the water is free from hardness.

Q4. Hard water causes kettles to fur. This fur can be removed by using an acid. Justify.

Ans: Using hard water in kettles produces calcium carbonate scale or fur.
Hydrochloric acid can be used to clean calcium carbonate (fur) deposits from kettles.
$CaCO_{3\,(s)} + 2HCl_{(aq)} \longrightarrow 2CaCl_{2\,(aq)} + CO_{2\,(g)} + 2H_2O_{(l)}$

Q5. The following chemical equation is about a calcium compound.

$$\text{Comp A} + Ca(OH)_2 \longrightarrow \text{Comp B} + H_2O$$
$$\text{Comp B} + H_2CO_3 \longrightarrow \text{Comp C}$$

a) Name and give the formula of
i. Compound A ii. Compound C

b) Describe with the aid of a balanced chemical equation. What happens when compound C is heated?

c) Compound C is soluble in water. Write a balanced chemical equation to show what happens when its aqueous solution is treated with washing soda?

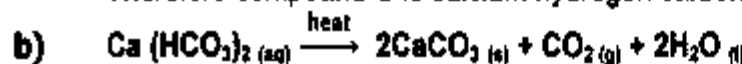
Solution: a) i. Compound A

$Ca(HCO_3)_{2\,(aq)} + Ca(OH)_{2\,(s)} \longrightarrow 2CaCO_{3\,(s)} + 2H_2O_{(l)}$
Therefore compound A is calcium hydrogen carbonate $Ca(HCO_3)_2$.

ii. Compound C

$CaCO_{3(s)} + H_2CO_{3\,(aq)} \longrightarrow Ca(HCO_3)_{2\,(aq)}$
Therefore compound C is calcium hydrogen carbonate $Ca(HCO_3)_2$.

b) $Ca(HCO_3)_{2\,(aq)} \xrightarrow{heat} 2CaCO_{3\,(s)} + CO_{2\,(g)} + 2H_2O_{(l)}$

c) $Ca(HCO_3)_{2\,(aq)} + Na_2CO_{3\,(aq)} \longrightarrow CaCO_{3\,(s)} + 2NaHCO_{3\,(aq)}$

Q6. How chemistry helps maintain a clean swimming pool? Explain.

Ans: Water in swimming pools is purified from pathogenic organisms by aeration and chlorination. Chlorination is probably the best and the cheapest method of sterilization of water and it is the most effective in destroying pathogenic bacteria. For chlorination, liquid chlorine may be added directly in the swimming pool water.

Q7. It is advisable to wash hands well with soap after using bathrooms. Evaluate it.

Ans: If your hands are not clean and you touch your face or public surfaces, you may be infecting yourself and others by spreading germs and disease. Colds, flus, and infectious diarrhea are all known to be spread by hand-to-hand contact. Washing your hands regularly can help keep you and those around you healthy by controlling the spread of germs (bacteria and viruses).

Q8. Water born diseases are no longer common in developed countries. Defend this statement.

Ans: Most waterborne diseases occur worldwide. In developed (western) countries, contagion (infections) is prevented by drinking water purification and by hygienic measurements.

But even in developed countries, people can fall ill from waterborne diseases. This is caused by using insufficiently disinfected water, by implementing non-hygienic food preparation and by insufficient personal hygiene.

GUESS PAPER & MODEL PAPER # 08
BASED ON CHAPTER # 16 (Reduced Syllabus)
CHEMICAL INDUSTRIES

CHAPTER 16 : **CHEMICAL INDUSTRIES**

Topics: Basic metallurgical operation Solvay process, Urea, Fractional distillation of petroleum.

Note: Topic related self-assessments, review exercise and think tank questions are included. Side boxes and Society, science and technology are not included.

SECTION-A

Time allowed: 20 Minutes **Marks: 12**

Note: Section-A is compulsory. All parts of this section are to be answered on the question paper itself. It should be completed in the first 20 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Encircle the correct option i.e. A / B / C / D. All parts carry equal marks.

i. The naturally occurring metallic compounds are called as
A. ore B. gangue C. mineral D. rock

ii. The percentage of nitrogen (N) in urea (CH_4N_2O) is
A. 0.5 B. 0.466 C. 0.4 D. 0.2

iii. Which of the following steps is not used in the extraction process of metals
A. roasting B. smelting C. flotation D. bessemerization

iv. Compounds which are added in the soil to provide essential elements to plants are called
A. carbonates B. salts C. fertilizers D. metals

v. Solvay process is used to make
A. NaCl B. potassium C. sodium carbonate D. NaOH

vi. The raw materials for the Solvay process include
A. ammonia B. brine C. lime stone D. all of above

vii. Chemical formula of slaked lime is
A. $CaCO_3$ B. CaO C. $Ca(OH)_2$ D. $CaCl_2$

viii. Calcination is the process in which sodium hydrogen carbonate is heated to get sodium carbonate. Which is not obtained in this process?
A. CO_2 B. CO C. Na_2CO_3 D. H_2O

ix. Percentage of nitrogen in urea is
A. 35 B. 21.2 C. 80 D. 46.6

x. What happens when ammonium carbamate is distilled with steam?
A. ammonia is produced B. carbon dioxide is released
C. urea is produced D. urea solution is produced

xi. Formula of halite is ____________.
A. NaCl B. 2NaCl C. Cl_2 D. Na_2Cl

xii. Formula of cassiterite is __________.

CHEMISTRY SSC-II

Time allowed: 2:40 hours | **Total Marks: 53**

Note: Answer any six parts from Section 'B' and attempt any five parts from Section-C. Attempt any two questions from Section 'D' on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

- i. Petroleum is a source of fuels. Name two fuels which are not obtained from petroleum.
- ii. What is slaked lime? How is it produced?
- iii. Write chemical reactions that take place during carbonation in Solvay process.
- iv. Explain the process "Roasting" with two examples.
- v. Write chemical reactions that take place during urea formation.
- vi. Define mineral, gangue and ore.
- vii. Describe composition of urea.
- viii. Make a list of raw materials for Solvay process.

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

- i. Explain the process of Magnetic Separation.
- ii. Explain the process of Cyclone Separation.
- iii. Explain the process of Flotation Process.
- iv. List the advantages of Solvay process.
- v. Why fertilizers are added to the soil?
- vi. List the classification of fertilizers?
- vii. Why urea is one of the widely used fertilizer?

SECTION – D (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks. (2 × 10 = 20)

Q4.
- a. Draw flow sheet diagram for manufacture of urea.
- b. Explain refining or purification of copper metal?

Q5.
- a. Outline basic reactions of Solvay process.
- b. What has to be done to crude oil before it is useful?

Q6.
- a. Draw flow sheet diagram of Solvay process.
- b. Describe briefly the fractional distillation of Petroleum.

SOLUTION OF GUESS PAPER & MODEL PAPER # 8
(Reduced Syllabus)

SECTION- A (MCQs)

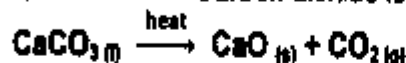
i. C	ii. B	iii. C	iv. C	v. C	vi. D
vii. C	viii. B	ix. D	x. D	xi. A	xii. C

SECTION – B (Marks 18)

Q.2 Attempt any SIX parts from the following. All parts carry equal marks. (6 × 3 = 18)

ii. What is slaked lime? How is it produced?

Ans: Slaked lime is $Ca(OH)_2$.

Preparation of slaked lime: Carbon dioxide is produced by heating limestone in a kiln.

$$CaCO_{3(l)} \xrightarrow{heat} CaO_{(s)} + CO_{2(g)}$$

Carbon dioxide is fed into the carbonating tower from the top. Equal amounts of lime (CaO) and water are mixed to produce slaked lime, $Ca(OH)_2$.

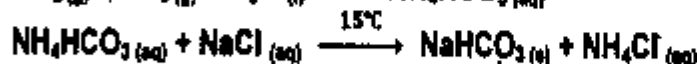
$$CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_2$$

iii. Write chemical reactions that take place during carbonation in Solvay process.

Ans: Carbonation:

In the carbonating tower, carbon dioxide is passed through ammonical brine. Following reaction takes place in it.

$$CO_{2(g)} + NH_{3(g)} + H_2O_{(l)} \longrightarrow NH_4HCO_{3(aq)}$$

$$NH_4HCO_{3(aq)} + NaCl_{(aq)} \xrightarrow{15°C} NaHCO_{3(s)} + NH_4Cl_{(aq)}$$

In the lower compartments of carbonating tower, the temperature of the mixture is lowered to 15°C. At this temperature, $NaHCO_3$ precipitates out.

iv. Explain the process "Roasting" with two examples.

Ans: Roasting:

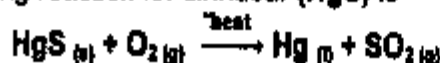
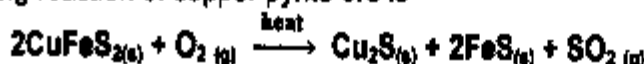
Some minerals are converted to oxide by heating in the air at temperature below their melting point. This process is called **roasting**. For example, the roasting for zinc blende (**ZnS**) is

$$2ZnS_{(s)} + 3O_{2(g)} \xrightarrow{heat} 2ZnO_{(s)} + 2SO_{2(g)}$$

Roasting reaction for cinnabar (**HgS**) is

$$HgS_{(s)} + O_{2(g)} \xrightarrow{heat} Hg_{(l)} + SO_{2(g)}$$

Roasting reaction of copper pyrite ore is

$$2CuFeS_{2(s)} + O_{2(g)} \xrightarrow{heat} Cu_2S_{(s)} + 2FeS_{(s)} + SO_{2(g)}$$

v. Write chemical reactions that take place during urea formation.

Ans: The raw materials for the manufacture of urea are:

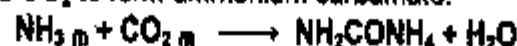
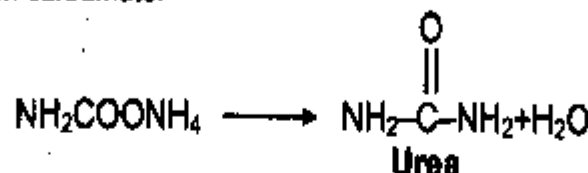
Manufacturing of urea consists of following steps.

i) Ammonia (NH_3) ii) Carbon dioxide (CO_2)

I) Reaction between NH_3 and CO_2 to form ammonium carbamate.

$$NH_{3(l)} + CO_{2(l)} \longrightarrow NH_2CONH_4 + H_2O$$

II) Distillation of ammonium carbamate.

$$NH_2COONH_4 \longrightarrow NH_2-\overset{\overset{O}{\|}}{C}-NH_2 + H_2O$$

Urea

III) Evaporation of liquid urea and its granulation.

The urea solution is concentrated in vacuum evaporators, which is then rapidly cooled and sent to the prilling tower. Urea prills thus produced are packed and then marketed.

vi. Define mineral, gangue and ore.

Ans: Mineral: The naturally occurring metallic compounds are called minerals.

Gangue: The debris, such as sand, rock and clay attached with the mineral is called gangue.

Ore: An ore is a solid deposit containing a sufficiently high percentage of a mineral to make extraction of metal economically feasible.

vii. Describe composition of urea.

Ans: Urea:

Urea or **carbamide** is an organic compound with the chemical formula $CO(NH_2)_2$. The molecule has two $-NH_2$ groups joined by a carbonyl (C=O)

viii. Make a list of raw materials for Solvay process.

Ans: Solvay process:

Sodium carbonate (Na_2CO_3) or soda ash is an important industrial chemical. It is used in the manufacturing of glass, soaps, detergents, paper and many other important chemicals. Sodium carbonate is manufactured in a continuous process known as the Solvay process.

Raw Materials: Commercially, sodium carbonate is manufactured in a continuous process that uses:

a) Ammonia

b) Brine (concentrated sodium chloride solution)

c) Lime stone as a source of carbon dioxide and slaked lime, $Ca(OH)_2$

SECTION – C (Marks 15)

Q.3 Attempt any FIVE parts from the following. All parts carry equal marks. (5 × 3 = 15)

i. Explain the process of Magnetic Seperation.

Ans: Process of Magnetic Separation

For magnetic ore, a magnet is used to remove mineral, leaving the gangue behind. The powered ore is dropped over a moving belt. Belt moves over two wheels, one of which is magnetic. It attracts the magnetic ore, so it falls nearer to the magnetic wheel. While non-magnetic impurities fall further away.

ii. Explain the process of Cyclone Separation.

Ans: Where large density differences exist between ore and impurities, a cyclone separator is used. In this method air under high pressure is blown through the pulverized ore. The lighter gangue is blown away through the top. But the denser mineral rich particles hit the walls by centrifugal force. They fall down the funnel.

iii. Explain the process of Flotation Process.

Ans: Pulverized ore is fed into a tank containing water and an oil-detergent mixture. The mixture is agitated with air. Detergents wet the mineral particles but not the silicate gangue. The mineral particles rise to the top of the mixture as a forth, from where they are skimmed off. Particles of the gangue fall down to the bottom. The copper ore is concentrated generally by flotation process.

iv. List the advantages of Solvay process.

Ans: Advantages of Solvay process:

i) It is a cheap process. The raw materials are cheap and easily available.

ii) It is a pollution free process. No harmful products are produced.

iii) It consumes less fuel. This is because there is no solution to be evaporated.

iv) Carbon dioxide and ammonia are recovered and re-used in the process.

v) It produces pure $NaHCO_3$ and Na_2CO_3

v. Why fertilizers are added to the soil?

Ans: Importance of fertilizers:

Crops take nutrients from the soil, and these must be replaced before the next crop is sown.

Fertilizers are the compounds which are put in the soil to provide elements essential for plant's life. They are added to the soil to make up the deficiency caused by the previous crops.

vi. List the classification of fertilizers?

Ans: Classification of fertilizers: Fertilizers are classified into two categories:

1. Natural fertilizers: Natural fertilizers or manures derived from animals and human wastes.

2. Synthetic fertilizers:

Synthetic fertilizers i.e. urea $CO(NH_2)_2$, ammonium sulphate $(NH_4)_2SO_4$, ammonium phosphate $(NH_4)_3PO_4$, calcium super phosphate $Ca(H_2PO_4)_2$ and di-ammonium phosphate $(NH_4)_2HPO_4$.

vii. Why urea is one of the widely used fertilizer?

Ans: Urea is one of the widely used fertilizer because of the following qualities:

i) Percentage of nitrogen is highest among all the synthetic nitrogen fertilizers i.e. 46%.

ii) It does not affect the texture of the soil.

iii) In the soil it hydrolyses quickly to ammonium carbamate which eventually changes into NH_3 which

SECTION – D (Marks 20)

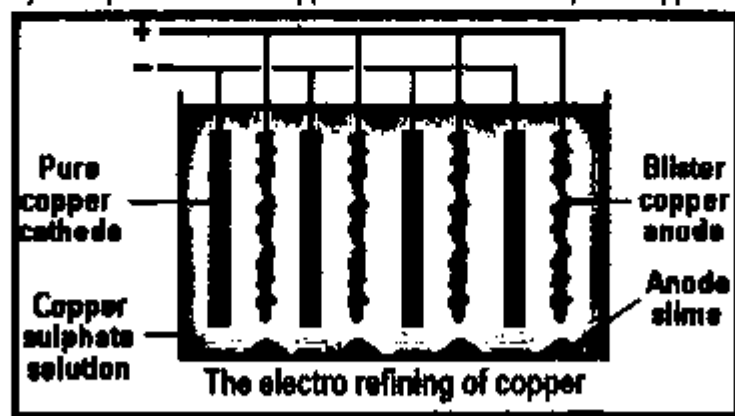
Note: Attempt any TWO questions. All questions carry equal marks. **(2 × 10 = 20)**

Q4. a. Explain refining or purification of copper metal?

Ans: Electro-refining of copper metal:

An electrolytic cell is used in electro-refining, in which impure metal acts as the anode and a sample of pure metal acts as the cathode.

For example, electrolytic refining of copper is carried out in an electrolytic tank containing acidified copper sulphate solution as electrolyte. Impure slabs of copper act as anode and pure copper sheets as cathode.

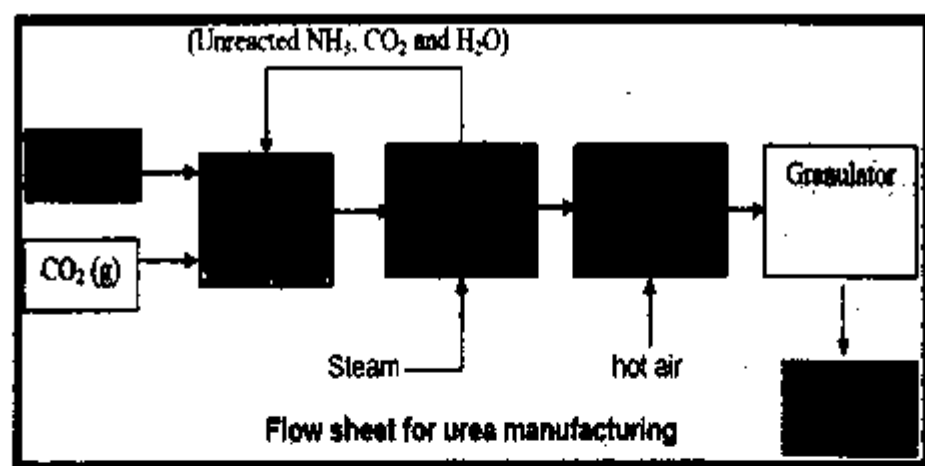
The electro refining of copper

On passing electric current through the solution, impure copper dissolves forming Cu^{+2} ions. These Cu^{+2} ions gain electrons at cathode and form Cu atoms, which are deposited on the cathode. In this way pure copper is collected at cathode. The impurities like Au and Ag fall off the anode as anode mud.

Anode Reaction: $Cu_{(s)} \longrightarrow Cu^{+2}_{(aq)} + 2e^-$

Cathode Reaction: $Cu^{+2}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$

b. Draw flow sheet diagram for manufacture of urea.

Solution:

Flow sheet for urea manufacturing

Q5. a. Outline basic reactions of Solvay process.

Ans: **i)** Preparation of ammonical brine **ii)** Carbonation
iii) Filtration **iv)** Calcinations
v) Preparation of carbon dioxide and slaked lime. **vi)** Recovery of ammonia

Basic Reactions: Solvay process consist of following steps

i) Preparation of ammonical brine:

Ammonical brine is prepared by dissolving ammonia gas in brine. Ammonical brine is fed into the carbonating tower.

ii) Carbonation:

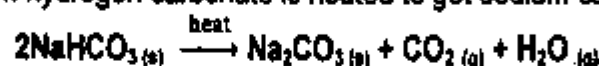
In the carbonating tower, carbon dioxide is passed through ammonical brine. Following reaction takes place in it.

In the lower compartments of carbonating tower, the temperature of the mixture is lowered to **15 °C**. At this temperature, **$NaHCO_3$** precipitates out.

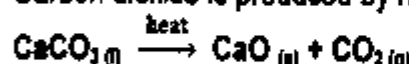
iii) Filtration:

Precipitates of **$NaHCO_3$** are separated from the milky solution by filtration. It is used as baking soda.

iv) Calcinations: Sodium hydrogen carbonate is heated to get sodium carbonate

$$2NaHCO_{3(s)} \xrightarrow{heat} Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$$

Carbon dioxide released is re-cycled in the process.

v) Preparation of carbon dioxide and slaked lime.

Carbon dioxide is produced by heating limestone in a kiln.

$$CaCO_{3(l)} \xrightarrow{heat} CaO_{(s)} + CO_{2(g)}$$

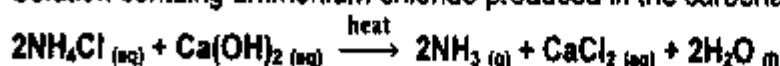
Carbon dioxide is fed into the carbonating tower from the top. Equal amounts of lime (**CaO**) and water are mixed to produce slaked lime, **$Ca(OH)_2$**

$$CaO_{(s)} + H_2O_{(l)} \longrightarrow Ca(OH)_2$$

Slaked lime is pumped to the ammonia recovery tower.

vi) Recovery of ammonia:

Solution containg ammonium chloride produced in the carbonation tower is heated with slaked lime.

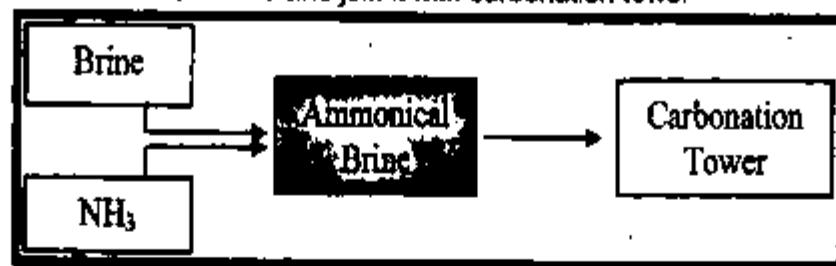
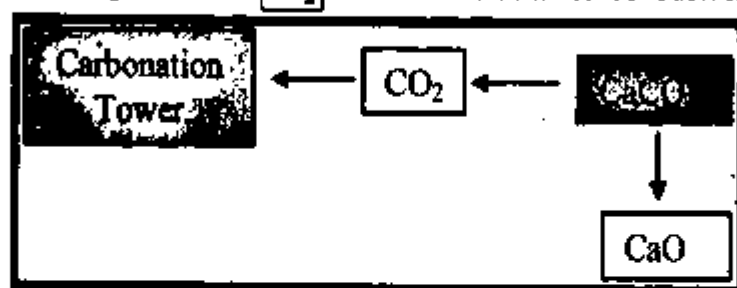
$$2NH_4Cl_{(aq)} + Ca(OH)_{2(aq)} \xrightarrow{heat} 2NH_{3(g)} + CaCl_{2(aq)} + 2H_2O_{(l)}$$

Almost all the ammonia is recovered in this process. It is reused in the process.

b. What has to be done to crude oil before it is useful?

Ans: Crude oil is a mixture of hydrocarbons. These are separated into useful products, such as fuels, using a process called fractional distillation in fractionating tower.

Q6. a. Draw flow sheet diagram of Solvay process.

Ans: Flow sheet diagram of Solvay process:

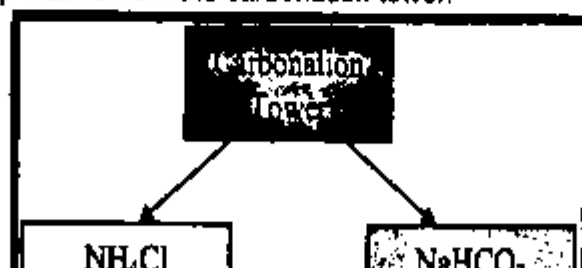
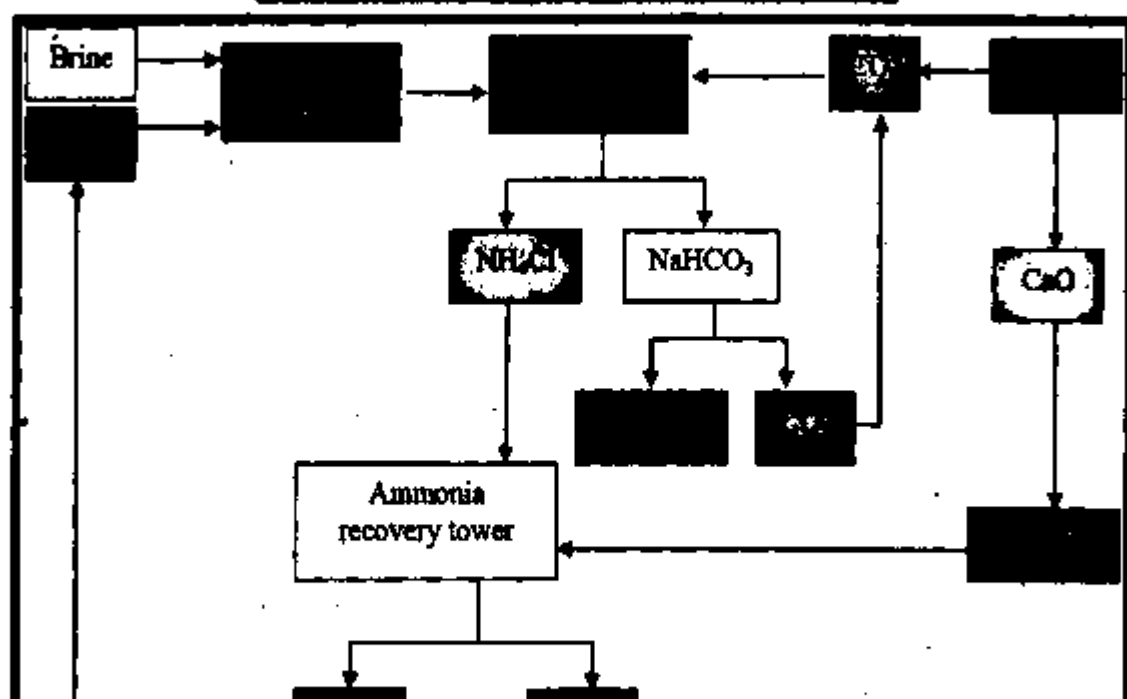
1. Represent each reactant, each product and each reaction chamber or container with one box.
2. Show formation of ammonical brine and join it with carbonation tower

3. Show the formation of **CO_2** with a box $\boxed{CO_2}$ and connect it with carbonation tower.

4. Show formation of two products from the carbonation tower.

6. Show ammonia recovery:

a) First show formation of $Ca(OH)_2$ from CaO and H_2O.

$$\boxed{Ca(OH)_2} \xleftarrow{H_2O} \boxed{CaO}$$

b) Connect $\boxed{NH_4Cl}$ and $\boxed{Ca(OH)_2}$ with ammonia recovery tower.

c) Show products of ammonia recovery tower, NH_3 and $CaCl_2$. Also show recycling of NH_3

b. Describe briefly the fractional distillation of Petroleum.

OR

How important fractions of petroleum are separated?

Ans: Refining:

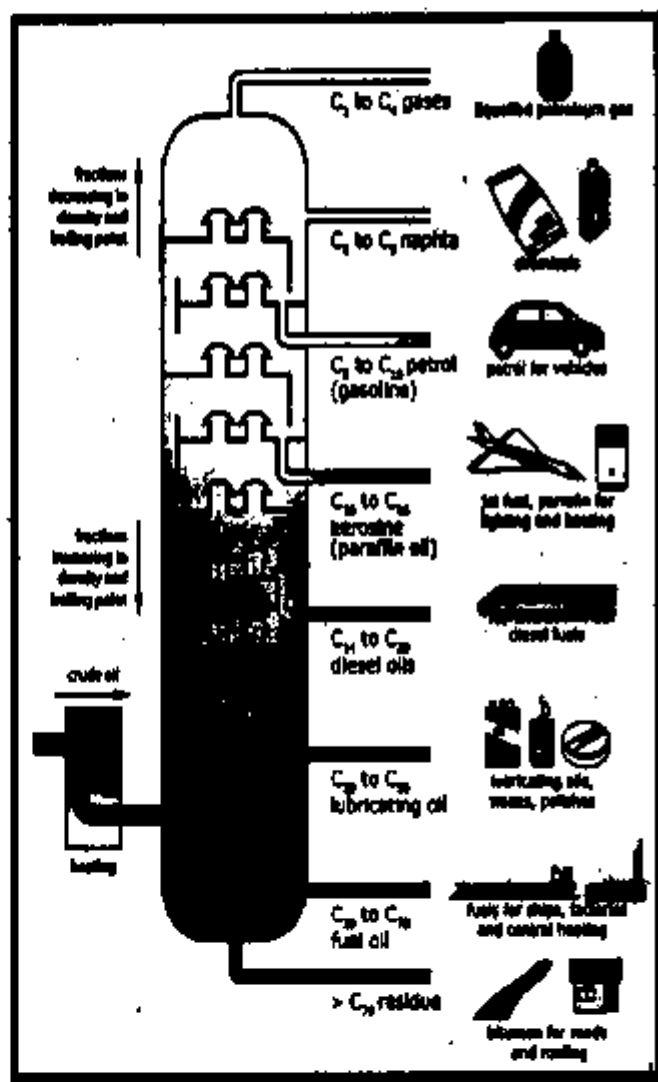
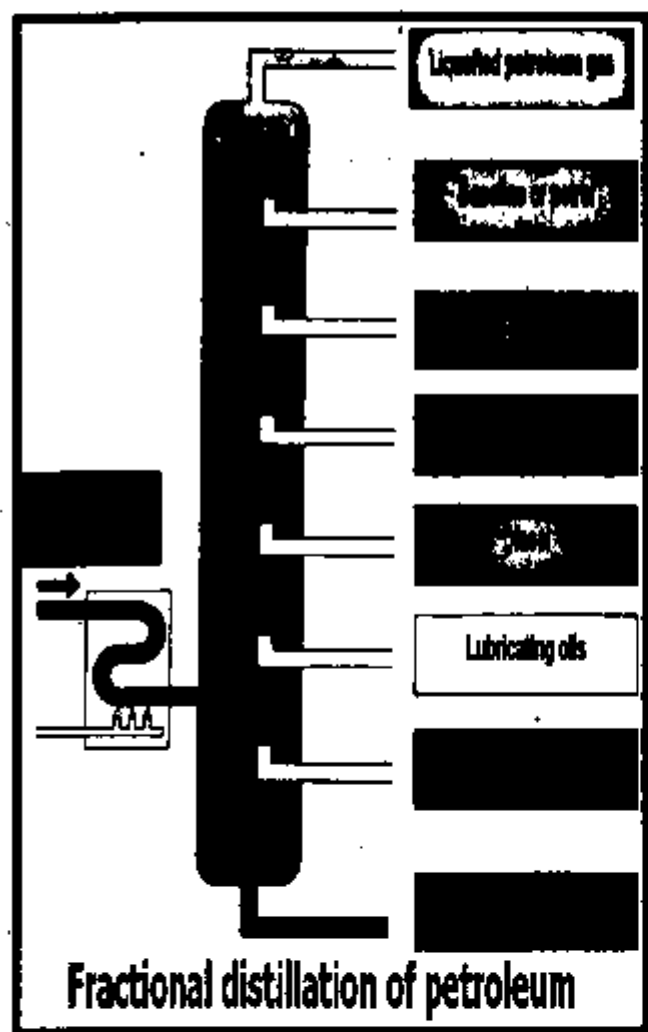
The conversion of crude oil into useful products is called **refining**. These useful products are called fractions. Each fraction consists of a mixture of hydrocarbons which boil in a certain range of temperature.

Fraction distillation:

Petroleum is refined by fractional distillation in a tall fractionating tower. The crude oil is heated up to 400°C under high pressure in a furnace. Then it is passed through the fractional distillation column. Its vapours rise through the column.

As hot vapour move up, they condense according to their boiling points into various fractions. Compounds with highest boiling points condense first near the bottom. Compounds with lowest boiling point condense last near the top. Compounds which do not boil, collects at the bottom as residue. In this way vapour condense gradually at different levels according to their boiling points. Therefore, crude oil is separated into various fractions. Each fraction has its own specific boiling range and composition.

Flow sheet diagram of refining of petroleum:

Fractional distillation of petroleum

Important Questions & Answers (Reduced Syllabus)

Q1. Make a list of metallurgical operations.

Ans: Metallurgy:

iii. Extraction of metal iv. Refining of metal

Self-Assessment Exercise 16.1

1. List important ores of iron, copper, zinc and mercury.

Ans: Important ores of iron, copper, zinc and mercury:

Metal	Name of ore	Formula
Iron	Haematite	Fe_2O_3
Iron	Magnetite	Fe_3O_4
Copper	Chalcopyrite	$CuFeS_2$
Zinc	Zinc blende	ZnS
Mercury	Cinnabar	HgS

2. List main processes used to concentrate the ore.

Ans: a) Magnetic Separation b) Cyclone Separation c) Flotation Process

3. Write names of methods used in the extraction of a metal from its concentrated ores.

Ans: i. Roasting ii. Smelting iii. Refining

4. List methods used to purify metals.

Ans: i. Electro-refining ii. Distillation

Self-Assessment Exercise 16.2

Make a list of raw materials of Solvay process.

Ans: Raw Materials: Commercially, sodium carbonate is manufactured in a continuous process that uses:

a) Ammonia b) Brine (concentrated sodium chloride solution)

c) Lime stone as a source of carbon dioxide and slaked lime, $Ca(OH)_2$

Self-Assessment Exercise 16.3

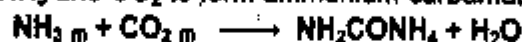
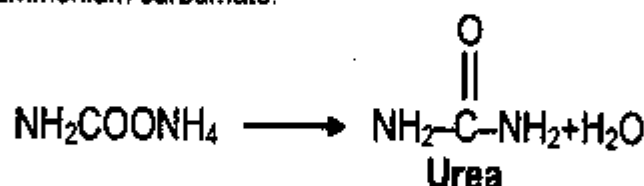
1. Calculate percentage of nitrogen in urea.

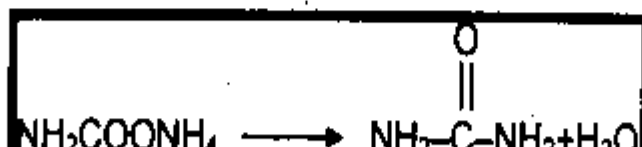
Ans: Molecular mass of Urea = NH_2CONH_2 = 14 + 2 × 1 + 12 + 16 + 14 + 2 × 1 = 60 g

$$\% \text{ of N} = \frac{\text{Mass of nitrogen} \times 100}{\text{Molecular mass of urea}} \quad ; \quad \% \text{ of N} = \frac{28 \times 100}{60} = \frac{2800}{60} = 46.6\%$$

2. Outline the basic reactions that take place in the synthesis of urea.

Ans: i) Reaction between NH_3 and CO_2 to form ammonium carbamate.

$$NH_{3(g)} + CO_{2(g)} \longrightarrow NH_2CONH_4 + H_2O$$

ii) Distillation of ammonium carbamate.

3. What happens when ammonium carbamate is distilled with steam?

Ans: Distillation of ammonium carbamate.

Q2. How are urea prills produced?

Ans: The urea solution is concentrated in vacuum evaporators, which is then rapidly cooled and sent to the prilling tower. Urea prills thus produced are packed and then marketed.

Q3. Describe the following with an example a) roasting b) smelting c) flotation

Ans: (a) Roasting:

Some minerals are converted to oxide by heating in the air at temperature below their melting point. This process is called **roasting.**

For example, the roasting for zinc blende (ZnS) is $2ZnS_{(s)} + 3O_{2\,(g)} \xrightarrow{heat} 2ZnO_{(s)} + 2SO_{2\,(g)}$

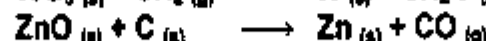
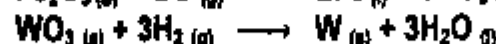
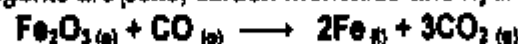
Roasting reaction for cinnabar (**HgS**) is $HgS_{(s)} + O_{2\,(g)} \xrightarrow{heat} Hg_{(l)} + SO_{2\,(g)}$

Roasting reaction of copper pyrite ore is $2CuFeS_{2(s)} + O_{2\,(g)} \xrightarrow{heat} Cu_2S_{(s)} + 2FeS_{(s)} + SO_{2\,(g)}$

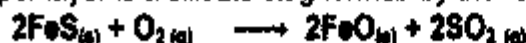
(b) Smelting: The method to reduce metal ions to free metal is called smelting.

The most common reducing agents are coke, carbon monoxide and hydrogen.

Some examples are:

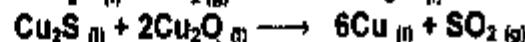
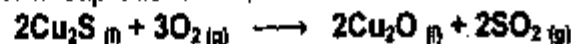
$$Fe_2O_{3\,(s)} + CO_{(g)} \longrightarrow 2Fe_{(l)} + 3CO_{2\,(g)}$$
$$WO_{3\,(s)} + 3H_{2\,(g)} \longrightarrow W_{(s)} + 3H_2O_{(l)}$$
$$ZnO_{(s)} + C_{(s)} \longrightarrow Zn_{(s)} + CO_{(g)}$$

However, smelting of copper ore is done in two steps.

i) **The roasted copper ore** is heated with coke and sand at about **1100°C**. The materials melt and separate into two layers. The bottom layer that contains mixture of Cu_2S and **FeS** is called matte. While the upper layer is a silicate slag formed by the reaction of **FeO** and sand

$$2FeS_{(s)} + O_{2\,(g)} \longrightarrow 2FeO_{(s)} + 2SO_{2\,(g)}$$
$$FeO_{(s)} + SiO_{2\,(s)} \longrightarrow FeSiO_{3\,(s)}$$

ii) Bessemerization:

In this process air is blown through the molten copper matte in a Bessemer converter.

Any remaining iron sulphide (**FeS**) is oxidized and removed as slag ($FeSiO_3$). In the final smelting step cuprous sulphide (Cu_2S) is oxidized to form cuprous oxide, which reacts with remaining cuprous sulphide to form metallic copper.

$$2Cu_2S_{(l)} + 3O_{2\,(g)} \longrightarrow 2Cu_2O_{(l)} + 2SO_{2\,(g)}$$
$$Cu_2S_{(l)} + 2Cu_2O_{(l)} \longrightarrow 6Cu_{(l)} + SO_{2\,(g)}$$

The product, called blister copper is about **97 to 99%** pure **Cu**, with entrapped bubbles of $SO_{2\,(g)}$ Bessemerization is also used to convert pure iron into steel.

(c) Flotation Process:

Pulverized ore is fed into a tank containing water and an oil-detergent mixture. The mixture is agitated with air. Detergents wet the mineral particles but not the silicate gangue. The mineral particles rise to the top of the mixture as a forth, from where they are skimmed off. Particles of the gangue fall down to the bottom. The copper ore is concentrated generally by flotation process.

Q4. Describe the physical properties and uses of petroleum fractions?

Ans: Fractions of petroleum and their uses:

Fraction	Number of carbon atoms per molecule	Boiling point °C	Important uses
Liquefied petroleum gas (LPG)	1-4	Below 20	Cylinder gas for cooking
Petrol	5-10	35-70	Fuel for motor cars and vehicles
Naphtha	8-12	70-120	Chemical feedstock for making drugs, plastics and other chemicals
Kerosene	10-16	170-250	Fuel for jet planes, fuel for heating, lighting and cooking
Diesel	14-20	270-340	Fuel for buses, truck and trains.
Lubricating oil	20-50	350-500	Lubricants for machines and engines, waxes and polishes
Fuel oil	50-70	500-600	Fuel for power stations, factories and ships